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U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF VEGETABLE PATHOLOGY.
BULLETIN No. 4.

EXPERIMENTS WITH FERTILIZERS
FOR THE
PREVENTION AND CURE OF PEACH YELLOWS,
1889-'92.

BY

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SPECIAL AGENT.

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LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Division of Vegetable Pathology,
Washington, D. C., January 10, 1893.

Sir: I have the honor to transmit herewith Bulletin No. 4 of this division, prepared by Dr. Erwin F. Smith, special agent in charge of the peach-yellows investigations. The bulletin embodies the results of four years' experiments with fertilizers to determine their value as preventives and cures of the disease in question. Throughout the entire work every detail received the personal attention of Dr. Smith, so that all statements made, unless otherwise indicated, are based on knowledge gained in this way. The adoption of this plan from the beginning necessitated an enormous amount of labor, but by way of compensation it gives a feeling of certainty not otherwise attainable. The fact that peach yellows can not be prevented or cured by fertilization of the soil is believed to be fully demonstrated; hence it is thought advisable to bring this line of work to a close.

Respectfully,

B. T. Galloway,
Chief of Division.

Hon. J. M. Rusk.
Secretary.

LETTER OF SUBMITTAL.

WASHINGTON, D. C., *January 10, 1893.*

SIR: I submit herewith an account of the experiments made during the past four years to determine the amount of truth in the hypothesis ascribing peach yellows to soil exhaustion and proclaiming potash salts and superphosphates as experimentally demonstrated remedies. The results each year substantially agree, and for this reason I have in accordance with your directions closed this phase of the investigation.

Respectfully,

ERWIN F. SMITH,
Special Agent.

B. T. GALLOWAY,
Chief of Division of Vegetable Pathology.

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PREVENTION AND CURE OF PEACH YELLOWS.

INTRODUCTION.

THE DISEASE IN QUESTION.

Wherever it occurs, the disease under consideration is known as peach yellows. This name has been in use for such a long time and is so well established that an attempt to substitute any other name would be unwise, although yellowness is uniformly characteristic only of the later stages of the disease.

Some confusion of ideas will be avoided by defining at the outset the manner in which this term is applied in the following pages. The symptoms of this disease, in brief, are as follows:

(1) The premature ripening of the fruit which is of inferior quality and has its skin and flesh unnaturally spotted and marbled with red.

(2) The premature unfolding of the winter buds. This may take place soon after they have begun to form in the leaf axils, *i. e.*, as early as June, or may be delayed until but a few days in advance of the proper time the following spring. It occurs very commonly in August, September, or October, while the spring foliage * remains and is still green, or while it is yellowing, or after it has fallen. This is a very striking and characteristic feature of the disease.

(3) The winter buds not only develop out of season, but resting buds and adventitious buds (?) sprout from the smooth or rough bark of the trunk and branches into erect, pale, feeble shoots, which are sometimes very abundant.

These are the primary symptoms and are not likely to be mistaken for those of any other disease. They may occur together, but the first often precedes the second or third by some weeks or months. Of course, in trees too young to bear, or which have missed a crop, the other symptoms will be the first to attract attention. A tree may show symptoms in all parts simultaneously, but generally such is not the case. Most often only one or two limbs are affected at first, and sometimes only a few twigs, the disease gradually involving more and more of the tree until, after some months or years, it shows symptoms in all parts.

If the abnormal shoots have pushed out early enough in the growing season, the buds in their leaf-axils also unfold into weak branches which frequently branch again the same season. The result of this hasty growth and excessive branching is a kind of hexen-besen composed of many feeble shoots bearing pale, dwarfed leaves.

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*The term "spring foliage" is here used to designate the ordinary foliage of the peach as distinguished from that which develops out of season under the influence of this disease.

Sometimes the spring foliage of affected limbs becomes noticeably yellow before the end of the first season, especially if the disease appears in early spring. On the contrary, if the first symptoms are not manifest until midsummer, the spring foliage often retains its normal color and appearance until the end of the season. The second year the foliage is dwarfed, yellowish or reddish, and frequently rolled inward at the edges and curved backward, but not flaccid. The shoot-axes are also dwarfed to a marked degree. The primary symptoms continue. The quality of the fruit is apt to be very inferior, and its size is usually much reduced.

Occasionally, trees badly attacked from the start die the second season, but more often they live from three to six years, becoming very yellow, stunted and unfruitful, and dying piece-meal.*

All the curative experiments mentioned in the following pages (exclusive of Experiment XC) were on trees having these symptoms, and all of the preventive treatments were on healthy trees in order to hinder the appearance of such symptoms.

If there is any obscurity as to the characteristics of this disease, it is certainly not in the minds of those who have had to deal with it at first hand. During the last few years the writer has had unrivaled facilities for observation, and whenever he speaks of peach yellows he refers to a definite and distinct set of symptoms, seen in thousands of trees, and as well known to intelligent growers in the affected districts as the peach tree itself.

DIVERSITY OF VIEWS AS TO THE CAUSE.

Naturally, a disease ruining orchards and causing heavy losses becomes the subject of much discussion and speculation, and the more mysterious the nature of the disease the more general the interest and the more conflicting the views. Peach yellows has been ascribed to half a hundred different causes, of which the following have been brought to my attention most prominently:

(1) Long-continued propagation by nonsexual methods, *i. e.*, budding, graftage, etc.
(2) The use of stocks grown from diseased pits.
(3) The use of buds or scions taken from diseased trees.
(4) The destruction of the tap-root during removal from the nursery.
(5) Crowding trees in the orchard (Parry).
(6) Neglect of pruning, especially of shortening in.
(7) Continued root pruning (by plowing) without a corresponding top-pruning (Mills).
(8) Bruises and other mechanical injuries (Maynard).

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* Those who desire a fuller account of symptoms are referred to the previous bulletins of this division, No. 9, 1888, and No. 1, 1891.

(9) Excessive cultivation.
(10) Long-continued neglect of culture.
(11) Overbearing.
(12) Sour sap.
(13) Transfer of pollen from diseased to healthy trees by bees or other insects (Prince).
(14) Proximity to Lombardy poplars.
(15) Some morbid affection in the air (Judge Peters).
(16) A bacterium (Burrill).
(17) A root fungus, and specifically the mycelium of an *Agaricus*. More recently *A. melleus* (Meehan).
(18) The peach borer (*Ægeria exitiosa*) (Maynard *et al.*).
(19) The scolytid beetle (*S. rugulosus*).
(20) The root aphis (*A. persicæ-niger*).
(21) The leaf mite (*Bryobia pratensis*).
(22) Some new, unknown, shy insect (Darling).
(23) Excessive rainfall (Peters, and many since).
(24) Proximity to water courses, or damp places.
(25) Want of proper drainage.
(26) Dry summers.
(27) The after results of very hard winters, *e. g.* 1856–'57 and 1880–'81 (Appleton).
(28) The effect of autumn frosts on unripened wood (Saunders).
(29) Too rich soils (Many growers).
(30) The excessive use of animal manures (Many growers).
(31) The long-continued use of commercial fertilizers (Growers).
(32) Starvation due to the washing out of plant foods from the soil by excessive precipitation.
(33) Infertility due to excessive cropping or to physical conditions.
(34) Soils deficient in lime (Rutter *et al.*).
(35) Soils deficient in potash and phosphoric acid (Goessmann *et al.*).

These various hypotheses fall into four principal categories:

I. Defective methods in the nursery and orchard.
II. The action of parasites or of mechanical injuries.
III. Abnormal climatic conditions.
IV. Chemical or physical defects of the soil.

The first two classes have been discussed elsewhere and are still under consideration. The last two will be considered in the following pages, more especially soil exhaustion.

REASONS FOR UNDERTAKING THESE EXPERIMENTS.

The wide publicity given to the views of Goessmann, Penhallow, Fuller, Hale, Minch, and others, who have advocated the use of potash salts and superphosphates as a preventive and a cure for this disease, is well known, and the frequent statements by the gentlemen themselves, that the results obtained were very satisfactory, certainly warranted the careful repetition of their experiments, under varying conditions and on a scale large enough to be comparable with the regular operations of the fruit-grower who desires, not fine-spun theories, but facts and methods which he can himself apply with a reasonable assurance of success. The destructive nature of the disease and the great losses it has caused in recent years also seemed, and still seem, sufficient warrant for undertaking any experiments offering even a moderate prospect of success.

KINDS OF TREATMENT.

Two kinds of treatment were tried, (*a*) curative and (*b*) preventive. First, it was sought to find out whether the affected trees were starving or suffering from an insufficient amount of food. Potash, phosphoric acid, lime, nitrogen, and other plant foods were, therefore, added to the soil to determine whether they possessed any curative or restorative virtue. Second, by using the same substances on healthy trees it was sought to learn whether they could be nourished and strengthened to such a degree that they would resist the disease. Much effort was expended on this second hypothesis, owing to a rather widespread popular belief, shared also by some scientific men, that even parasitic diseases are most likely to attack weak organisms, and that by good cultivation and generous treatment plants may be made healthy enough to resist.

THE SELECTION OF ORCHARDS.

The orchards used in these experiments are, or were, on the upper part of the Delaware and Chesapeake peninsula in the heart of the great peach region, in localities formerly free from yellows, but recently much subject to it.

In selecting these orchards the greatest care was exercised to secure representative conditions. Fifteen orchards are included in these experiments, numbering more than 16,000 trees and representing a variety of soils, elevations, and horticultural methods. Speaking in general terms, two types of soil are represented: (1) The clays of the higher terraces of northern Maryland, and (2) the sands of the lower plains of middle Delaware, both being estuary deposits.

FERTILIZERS USED.

The guano, dried blood, superphosphates, and salts of potash and nitrogen were procured from the Bowker Fertilizer Co., in Boston. The prices per ton paid for the various substances were about as follows, varying a little in different years: Guano, $56; dried blood, $45; muriate of potash, $42; kainit, $12.50; kieserite, $15; dissolved bone black, $25; dissolved bone ash, $25; nitrate of potash, $120; nitrate of soda, $45; sulphate of ammonia, $75.

The Canada hard-wood ashes came from Monroe, Judson & Stroup, Oswego, N. Y., and cost, in bulk, about $14 per ton, exclusive of freight. They were of quite uniform composition and rich in potash.

The lime used on Series VII was bought of a local dealer, and its origin is unknown. That used in Series XII came from Wrightsville, Pa.

The tobacco dust was selected in Baltimore, Md., and cost $30 per ton.

The substances were guaranteed as represented, the dealers knew the use to which they would be put, the prices paid were sufficient to insure a good quality, and finally every package received personal inspection to determine whether it was of uniform character and standard excellence. Under the circumstances, chemical analyses were not considered necessary.

THE METEOROLOGY OF THE DELAWARE AND CHESAPEAKE PENINSULA, WITH SPECIAL REFERENCE TO THE ORCHARDS UNDER TREATMENT, AND THE YEARS 1889–'91.

These experiments would be incomplete without a careful consideration of the accompanying climatic conditions. Until recently there have been no regularly appointed meteorological stations in the region under consideration, and the eastern shore of the Chesapeake is still unrepresented. The following statements are, therefore, drawn from the writer's own notebooks and from the very useful private records of three local observers—Dr. W. S. Maxwell, Still Pond, Md., and Dr. Henry Ridgely and Mr. John Jester, Dover, Del. By way of introduction, it should be stated that the climate of this region is mild and that the annual rainfall is always very considerable, as might be expected from its surroundings.

RAINFALL.

Without entering into details it may be said that the growing seasons of 1886 and 1887 were rainy over the whole upper part of the Delaware and Chesapeake peninsula and that the season of 1888 was correspondingly dry. As is well known, the rainfall is a variable quantity even within short distances; the precipitation was therefore studied in the immediate vicinity of the treated orchards.

Rains and rainy days at Still Pond, Md.

Dr. W. S. Maxwell has kept a daily record of events of local interest for more than twenty years, and from this the following statements have been condensed, no rain-gauge record existing:

1889.

April 1, 4, 6, 12, 13, 16, 20, heavy; 25, heavy—ground soaked; 27, heavy; 28.

May 1, 3, 10, 14, heavy; 19, 20, in torrents—a flood; 21, 22, 24, 25, rained all night, ground too wet to work; 26, 27, the ground is soaked; 30, 31. A wet month. Some farmers not done planting corn.

June 10, 11, heavy; 12, 13, 14, heavy; 15, heavy; 17, heavy; 21, 25, 26, 28, 29.

July 1, 2, heavy; the ground is soaked; 3, 4, 11, heavy; 13, heavy; 15, 19, 25, light; 26, heavy; 27, 28, light; 29, 30, 31, heavy. Too wet to plow wheat fallow.

August 1, heavy, the ground is soaked; 2, light; 3, 5, light; 9, light; 10, 11, heavy; 23, light; 24, (very dry on 30th).

September, dry and dusty on 8th; 10, 11, 12, 13, 14, 15, heavy; 17, heavy; 18, 20, light; 24, 25, 26, 30.

The only dry spell during the six months was between August 24 and September 10. As a whole the season was the wettest in years, surpassing 1886 and 1887, both of which were considered unusually wet seasons.

1890.

April 4, 8, 9, 10, 24, 25, 26, 27; a dry spell from the 10th to the 24th.

May 1, heavy; 4, ground very wet; 6, 8, very wet; 10, 11, 13, 14, 15, 20, heavy; 23, 26, heavy.

June 6, 12, 16, 21, which has been needed; 22, a fine rain; 24, heavy.

July 2, 13, light; 15, heavy; 24, light; 25, heavy; 28, 29.

August 1, 5, 8, ground very wet; 12, 13, 14, 18, 19, heavy; 20, 21, heavy; 26, ground very wet; 29.

September 5, light; 11, 12, 13, 14, 15, 16, ground very wet; 26.

The season was dryer than 1889. There were only six rains in June and seven in July; but there was no prolonged drought, such as was experienced in Delaware.

1891.

April 2, heavy; 4, light; 10, light; 11, 18, heavy; 22, light; 23, light; 24, light.

May 3, heavy; 5, snow squalls; 6, snow and rain; 11, light rain; 15, light, all day; 22, heavy; 23, light; 24, heavy; 25, light; 26, light; 27, light; 28, light; 29, light; 31, light.

June 4, heavy; 7, 17, 18, 19, light; 20, light; 21, heavy; 22, heavy; 26, light.

July 1, 2, heavy; 3, heavy; 7, 8, heavy; 15, light; 18, 19, and 20, very damp; 23, light rains; 24, light; 25, light; 28, heavy; 29, light; 30, heavy.

August 1, 2, 3, and 4, clouds, sunshine, and rains; 11, light; 12, heavy; 15, heavy; 21, 24, heavy; 25, light; 27, light; 29, light; 30, light.

September 1, 4, heavy; 5, heavy; 6, 8, light; 12, light; 28, a few drops of rain (very dry); 29, light.

My own incomplete records for Still Pond and vicinity are as follows:

1889.

May 9.—April on this peninsula was rainy. The Baltimore Sun reports 8.70 inches at Baltimore and the precipitation was probably more than that here.

May 16.—There was a heavy rainfall the night of May 13-14 and another May 14-15. According to a correspondent of the Kent News the rainfall at Galena, Md., for April was 5.97 inches.

May 20.—Rain last night for some hours; also a very heavy, soaking rain this forenoon, and rain again in p. m.

May 23.—Rain from 3:20 p. m. yesterday until 3 this a. m. A heavy precipitation, the ground being already quite wet. Many low fields are under water. It is a very wet spring all over the peninsula.

September 5.—The rains during the summer prevented continuous cultivation. The entire spring and summer into August were excessively rainy, the rainiest season in years. All low-lying peach orchards were under water both here and in Delaware. Many peach trees were killed by standing water—a very unusual occurrence.*

September 10.—Rainy with high wind from NE. *September 11* (p. m.).—Rainy; high N. and NE. wind. *September 13.*—Still rainy. *September 14.*—Rainy. *September 16.*—Rainy. *September 17.*—Completed observations in the orchard of F. H. Harper, with which rain has seriously interfered. *September 18.*—Rainy. *October 27.*—Heavy rains last night and this morning; the ground is very wet. *October 28.*—Soil in the Harper orchard too wet to plow. *November 2.*—No rain since October 27. *November 30.*—Many rains this month.

According to Dr. Maxwell's daily record, rain occurred on 106 days out of a possible 244, between April 1 and November 30, 1889.

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* Such trees developed no symptoms of yellows.

1890.

May 6.—Rain from 4 a. m. till noon, making the soil very wet (Shallcross orchard). *May 7-12.*—Several rains. *May 14.*—Rain last night. The weather so far this month has been cool and wet. *May 15.*—Heavy rain last night, beginning about 8 p. m. and continuing most of the night. Another heavy rainfall this a. m. The ground is very wet. *October 2.*—A very rainy day. *October 6.*—Rainy. *October 7.*—Rainy. *October 13 and 14.*—Rainy. *October 16.*—Rainy in p. m. *October 22.*—Rain last night. *October 23.*—Very rainy all day with a high wind.

1891.

April 15.—The spring has been rainy. Unusually heavy rainfall in January, February, March, and first week in April. *April 18.*—Heavy thunderstorm in evening. First rain in a week. *April 24.*—Shower last night. The first precipitation since 18th. *April 30.*—Another sunny day. Except the heavy thunderstorm of 18th and the light shower of 24th there has been no rain since the 10th. The earth is very dry.

May 3.—The thunder shower of last night was followed this a. m. by a gentle rain of some hours' duration. This is the first rain of any consequence since the gust of April 18, and was much needed. The earth is now wet down 5 inches. The soil has been so dry that many farmers have not yet plowed their peach orchards.

October 7.—Rain this p. m. The first in several weeks. *October 12.*—Cold rain.

October 22.—Rainy day.

Rains and rainy days at Dover, Del.

From the notebooks of Dr. Henry Ridgely I have compiled the following statements, no rain-gauge record existing:

1889.

March.—A nice month. Not much cold weather. Farmers have done a good deal of work. Very heavy rains about March 4 and again about March 20.

April 1, 2, rainy, foggy; 3, 6, 8, 12, 16, 17, 18, cloudy and like rain—very wet; 21, 25, 26, 27, very wet.

May 1, 10, 12, 13, 14, heavy; 15, 19, 20, big rain; 21, big rain; 22, very wet; 24, 25, 26, 27, heavy—very wet; 31.

June 1, big rain (still very wet on 3d); 4, 10, 11, 12, too wet to do anything; 13, 14, 15, very wet; 16, 17, 21, heavy (ground so wet and miry at W. O. on 22d that wheat-cutting had to be abandoned); 26, heavy—very wet; 29. June has been a very bad month. Corn is in very bad order and wheat is in a dangerous condition; some is molding in the shock and some can not be cut.

July 1, big rain; 2, heavy; 3, heavy; 4, very heavy; 11, heavy; 13, 15, raining in torrents; Division street is a solid sheet of water, 19, 20, 26, 27, 28, 29, 30, 31. July has been one of the wettest months known for many years and has entailed great loss on the community.

August 1, 2, 3, 5, a big rain; 10, 11, 15, a good rain; 23, a good rain.

September 6, 10, 17, ground very wet; 18, 24, 25, 26, very wet; 30, light.

October 1, 6, 13, a good rain; 14, all day; 22, 23, 26, 27. October has been a very dull month—a good deal of wet, cloudy, cold weather.

November 2, 3, 8, 9, 11, light; 13, 18, a big rain; 19, a big rain, very wet; 21, 22, 25, 27, a big rain; 28. November has been a very wet month. The rain of 18th and 19th left more water on the ground than any rain of the whole year. Wheat is submerged everywhere.

1890.

March 1, 6, 10, 11, 14, 15, snow; 19, a big rain; 20, 22, a big rain; 28, 31, snow.

April 4, 7, 8, a big rain; 9, 10, 17, 24, 25, 26, 27.

May 1, 4, heavy; 6, 8, 10, light; 14, 15, 16, 20, 23, light; 26.

June.—Warm and dry on 2d; hot and dry on 5th; 6, a good rain; 11, light; 12 light in morning, hard in evening; 21, a good rain; 22, a gust; 24, a gust, with some rain in night.

July 2, 3, 24, several rains after this date. July has been a very dry month. No rain worth speaking of from June 21 to July 24. Pastures and gardens suffered badly, and early corn. No plowing could be done until 27th; corn said to be much injured in the lower part of the county. Month also very warm, the 9th being the hottest day in 14 years in Philadelphia.

August 5, 6, 8, heavy; 12, 13, heavy; 19, a good rain; 20, 21, heavy; 25, heavy; 27. August has been a very wet month nearly all the way through, and very warm until the 23d. The great rains have helped the corn very much. Pastures are good.

September 6, 11, a good rain; 12, 13, 14, a big rain; 15, a big rain, 16, 17, heavy; 22, 26, heavy; 27, heavy.

October 2, heavy; 3, very wet; 6, heavy; 7, heavy, wheat seeding delayed; 12, 13, light; had to stop drilling wheat; ground too wet; 14, light; 16, a big rain; 19, 20, light; 23, a big rain; 25, 28. October has been a terrible month, raining all the time. Great damage has been done, particularly to potatoes, of which thousands of bushels have been destroyed. A good deal of buckwheat has been lost, and clover seed also. Great trouble in getting in wheat, a good deal of which is not yet sowed.

November—Very dry at close. No rain worth mentioning since the 12th. A bad year for farmers. Early potatoes were ruined by the drought in July and rains rotted nearly all the late ones. Tomatoes were cut short by the rains. All fruits were a failure; the same true of corn, wheat, and oats. The successful crops were timothy and pumpkins.

1891.

March 3, 6, snow; 8, light; 9, 12, a big rain; 20, a big rain; 21, prolonged; 22, heavy; 23, very wet; the ground is filled full of water. The bottom in my peach orchard, near the depot, has been full for some time; there is water on the Slaughter farm where it has never been seen before. This is the complaint everywhere; 27, a big storm; 28, 31, heavy. March has been a very wet month; a large portion of land is covered with water and no work done.

April 1, 2, 4, light; 10, light; 11, heavy; 18, 22, 23, a big rain.

May 3, a good rain; 6, 15, light; 20, 22, a good rain; 23, 24, 26, 28, 29.

June 4, a good rain; 7, a good rain; 12, shower; 18, a good shower; 19, heavy; 21, heavy; 26, light. The month closed warm and dry.

July 2, a rainy day; 3, 8, a rainy day; 15, a good rain; 18, heavy; 23, a big rain; 24, heavy; 25, light; 28, 29, heavy; 30, a good rain. A cool July and uncommonly wet.

August 1, 3, 4, 9, 12; 21, a good rain; 24, big rains; 25, 29, 30.

September 5, heavy; 6 (a break in record from 10th to 24th; hot and dry on 26th); 29. September has been a very dry month, and was very warm in the latter part.

My own partial records for the same period and locality are as follows:

1889.

April 16.—Rainy. *April 17.*—Rainy, in a. m. *April 21.*—Rainy last night. *April 26.*—Rain all last night and until 4 p. m. to-day, *i. e.*, twenty hours continuously—not a drizzle, but a steady pour, the like of which is rarely seen in this latitude. *April 27.*—Showers all day. *May 1.*—Rain in p. m., three hours.

1890.

April 20.—The soil is dry and rain is needed. *April 24.*—Gentle rain in p. m. for three hours. *April 25.*—Drizzling rain from 5 a. m. till noon. All soaked into the earth. *April 26.*—Rains again gently. *May 20.*—Very heavy rainfall in a. m., lasting two hours. *July 17.*—The roads in the vicinity of Dover are very dry and dusty, and vegetation is suffering for want of rain. Mr. Green says the season has been very dry; no rain for many weeks, except slight showers, which did little good.

The following newspaper clipping, dated Milford, Del., July 26, 1890, is reasonably correct:

No rain has fallen for nearly two months, and the face of the earth is parched as it has not been since 1838. Nearly every growing crop has been ruined, and the farmer feels that the plagues of ancient Egypt are being repeated in Delaware. The wheat crop just harvested has been only one-half a yield; the oat crop is less than one-fourth a full one; the berry crops have been shortened by the drought.

Corn is literally dried up from root to tassel, and a flood of rain could not revive it. Pastures are dried up and look as though fire had run through them. Farmers are feeding the hay saved last month to their stock, and wondering where they will get money with which to buy Western corn next winter. Last year floods of rain ruined nearly every crop, and this year the drought will prove even more damaging. Delaware's 5,000,000 peach trees generally furnish a reserve income that offsets any agricultural losses; but the peach crop is an entire failure this year. There is not a carload in the State. Poverty is present, and want is feared.

September 12.—Showers put an end to work.

September 13.—Very heavy showers in p. m. Mr. Jester says the drought began June 20 and continued until July 24. During this time there were only a few light showers. From July 4 to July 24 there was only one very light shower. After that there were seasonable rains.

September 14.—Rain all day.

September 15.—Rain began very early in a. m. Heavy until noon. A great deal of water has fallen in last forty-eight hours and the soil is very wet.

September 26.—Rainy. Exceedingly heavy precipitation.

October 2.—A very rainy day at Clayton and probably also at Dover.

October 23.—Very rainy all day, with a high wind.

1891.

April 9.—January, February, and March in this locality have been extremely rainy, many low fields and some orchards being under water. Many places where I never saw standing water before are converted into broad, shallow pools. On parts of some orchards the water has stood three weeks, but none of the treated ones have been flooded.

April 11.—Rain in a. m. and again in evening.

April 15.—Clear to this date.

May 11.—Weather continues very hot and dry.

May 15.—A gentle, soaking rain; the first for some weeks.

May 22.—Heavy thunderstorm in p. m. Earth soaked.

May 23 and 24.—Cloudy and lowering. Earth too wet for cultivation.

September 17.—Mr. Green says the peach rot was troublesome this year. It rained every few days during peach harvest, and was warm and cloudy. In no part of the season was there any long drought such as shortened the crops last year, but the rains have been quite uniformily distributed.

Rainfall (in inches) at Dover, Del., in 1891, from Mr. John Jester's record.—January, 6.14; February, 6.36; March, 9.47; April, 3.34; May, 2.49; June, 2.78; July, 8.59; August, 4.03; September, 1.00; October, 3.17; November, 1.67; December, 3.55. Total, 52.59.

DEPARTURES FROM NORMAL TEMPERATURES.

The winter of 1880–'81 was severe, and peach trees on the Delaware and Chesapeake peninsula were injured to a considerable extent. The fruit buds were destroyed and many branches were killed or injured by the cold. The lowest temperature was —14° F. This season is commonly known as "the winter of the great freeze." Since that date the winters have been comparatively mild, there having been no temperatures low enough to injure dormant fruit buds.

The only recent remarkable deviation from the normal was in the winter of 1889–'90, when the opposite extreme was reached, the season from November to March being like one long autumn. Most of the time the ground was free from frost and at no time was it frozen to any depth in eastern Maryland or Delaware. The conditions during this winter were of such an unusual nature that the following notebook records are introduced to give force to the general statement:

January 9.—Ground frozen for the first time at Dover, Del.

January 17.—Washington, D. C.: November, December, and January have been mild and open to a very unusual degree. There has been no snow or severe weather. Lawn mowers have been in use, and to-day the grass is as green as it was in October. In the parks many shrubs are in blossom—Forsythias, Jessamines, Spiræas, Lonicera's, the Japanese quince, etc. Dandelions, ox-eye daisies, chick-weeds, and most of the early wild flowers, such as Poa, Epigæa, Anemone, Hepatica, Corydalis, Draba, Houstonia, Alnus, and Symplocarpus, have been found in blossom recently. Peach buds are swollen, and diseased trees in Maryland and Delaware have already blossomed.

February 28.—Dr. Maxwell writes as follows: "Last Wednesday (26th) the mercury ranged from 70°–80°. It advanced vegetation wonderfully. A large per cent of the peach buds are open enough to take in moisture. * * * Le Conte pears are coming into leaf."

March 3.—The winter has been unusually mild along the Atlantic coast. Dr. Ridgely reports peach trees in blossom very generally at Dover, and says that some of the Kiefer pears are also in blossom. Shad were caught in St. Jones' Creek as early as March 1.

April 11.—The mild weather caused the peach buds to open several weeks in advance of the usual time, and the entire peach crop of the peninsula was destroyed by the cold snap which occurred early in March.

The winter of 1890–'91 was also mild, although not to be compared with that of 1889–'90. There was no zero weather. Cabbage stumps left in the field wintered over quite generally and were alive and growing in April. The lowest temperatures recorded at Dover by Mr. Jester were as follows (by Green's minimum thermometer): 19.5°, January 5; 19.9°, January 6; 19.5°, January 7; 19°, February 4; 16°, February 5; 15.5°, March 2.

The harmful spring frosts for the last few years have been as follows:

1885, 1886, 1887, 1888, none. 1889, none. Crop shortened by *Monilia*.

1890, March 1–9, and April 1, 2, 3, 6, 11, 19.—The Still Pond record of temperatures during the cold snap in March are as follows: March 3, 18° F.; 6, 20°; 7, 9°; 8, 20°; 9, 20°. The Dover temperatures were as follows: March 2, 27° 8 a. m., 30° 12:23 p. m., 28° 4:27 p. m.; 3, 20° 7:26 a. m., 28° noon, 33° 4:27 p. m.; 4, 29° 7:27 a. m. (ground frozen solid), 43° 11:38 a. m., 45° 4 p. m.; 5, 33° 7 a. m., 40° 11:37 a. m., 37° 3:38 p. m.; 6, 43° 7:21 a. m., 26° 11:51 a. m., 30° 3 p. m.; 7, 13° 7:22 a. m. (coldest morning of the winter), 25° 12:18 p. m., 28° 3:40 p. m.; 8, 23° 7:05 a. m., 30° 11:43 a. m., 32°

2:13 p. m.; 9, 23° 7:22 a. m., 37° 1:00 p. m., 39° 3:07 p. m.; 10, 29° 7:15 a. m. Milder later in the day.

1891, May 6.—At Dover, Del., ice formed one sixteenth inch thick, and on flat lands in the south half of this State the entire peach crop was destroyed, the young fruits being the size of hazel nuts.

During the last few years the first severe frosts of autumn have been as follows:

1885, October 10; 1886, October 17; 1887, October 15; 1888, October 10.

1889, after October 31. None severe enough up to this date to stop the growth of garden beans at Still Pond, Md.

1890, between October 24 and 30.

1891, between October 24 and November 2.

WEATHER BUREAU RECORDS.

An endeavor to correlate the marked decrease of cases in 1889 with weather conditions led to the following communication from Prof. Mark W. Harrington, Chief of the Weather Bureau:

Replying to your communication of the 5th instant, asking information in regard to the meteorological conditions which obtained between October 1, 1888, and September 30, 1889, in the upper part of the Delaware and Chesapeake peninsula, I beg to inform you as follows: The only stations in that vicinity at which regular meteorological observations have been made for a number of years are Baltimore and Philadelphia. It is true that observations are being made at Dover and Kirkwood, Del., but neither of these stations has accumulated sufficient data for the calculation of normal values. The departures from the normal temperature and precipitation for the stations at Baltimore and Philadelphia have been drawn off and the results are enclosed herewith. The period as a whole, so far as regards temperature, presents no specially abnormal features. The summer months, and also September, were cooler than the average. The summer of 1889 at Baltimore was the coolest on record with the exception of the summer of 1886. At Philadelphia there have been several summers slightly cooler than that of 1889. It is not usual for the temperature to remain below the normal for four consecutive months; in this case, however, the low temperature was no doubt due to the unusual rainfall as described below.

The precipitation for the twelve months ending September 30, 1889, was decidedly abnormal. More rain fell at Baltimore in the calendar year 1889 than in any other year since the establishment of the station in 1871. At Philadelphia the annual rainfall of 1889 was exceeded but once, in 1872. As you will observe by reference to the table there was a very great excess of rain at Baltimore from March to July, 1889, a greater excess than has ever been recorded for a corresponding period. In the year 1886 the conditions both as to temperature and rainfall approached somewhat closely to those of 1889, with the exception that the temperature of September in the former year was above the normal instead of below as in 1889. May of 1886 was, however, below the normal, thus giving four consecutive months in both years with temperature below normal. The precipitation at Philadelphia, if the period April to August be considered, was greater than for any corresponding period. The same months gave almost as much rain, however, in 1872.

Comparisons of the percentage of saturation of the air for the twelve months ending September 30, 1889, with the results of former years are not easily made. The old observations are not strictly comparable among themselves; part were made in ventilated and part in unventilated shelters, and, moreover, the hours of observation were changed from three times daily to twice daily in July, 1888. The observations subsequent to that date, not having the midday observation, give results, so far as averages are concerned, too high by about 7 or 8 per cent. It becomes necessary, therefore, in making comparisons of the average monthly relative humidity deduced from two observations per day with the same data calculated from three observations per day, to apply a correction to the first-named values. Applying such a correction to the average monthly relative humidity at Baltimore and Philadelphia, and calculating the departure of the corrected values from the normal, the results as shown on the accompanying tables are obtained. There is naturally a little uncertainty as to whether the corrected values represent the true means for the period in question; the best that can be said of them is that they are a very close approximation to the truth.

It will be noticed that the months, December to March, inclusive, were unusually dry, especially so at Baltimore. December, 1888, at Baltimore, was dryer than any previous December. With the exception of February, 1872, February, 1889, exceeded all previous months of that name in dryness. The periods, December, 1871, to March, 1872, at Baltimore, and December, 1873, to March, 1874, at Philadelphia, were similar to the one under consideration.

There are no unusual features noticeable in connection with the first and last frosts.

The foregoing statement gives only the general characteristics of the weather as presented by the monthly averages. A further study by the use of shorter periods would involve a very considerable amount of labor on account of the condition of the records. If, however, the facts here presented should throw any light upon the subject of your inquiry I shall be glad to furnish you with such additional information as may be practicable.

Departures from the normal.

Stations.	Jan., 1889.	Feb., 1889.	Mar., 1889.	Apr., 1889.	May, 1889.	June, 1889.	July, 1889.	Aug., 1889.	Sept., 1889.	Oct., 1888.	Nov., 1888.	Dec., 1888.	Annual.
Temperature:													
Philadelphia	+6.7	−6.5	+3.2	+2.2	+1.7	+0.4	−1.7	−1.2	−2.6	−6.4	+2.4	+1.1	−0.7
Baltimore	+5.9	−6.2	+2.4	+1.6	+0.8	−1.5	−1.4	−1.2	−2.5	−6.3	+1.9	+0.6	−5.9
Average	+6.3	−6.3	+2.8	+1.9	+1.2	−0.5	−1.5	−1.2	−2.5	−6.4	+2.2	+0.8	−3.1
Precipitation:													
Philadelphia	+0.31	−1.29	−0.52	+0.46	+1.59	+0.16	+3.88	+2.34	+1.37	+0.48	+0.63	+0.36	+9.77
Baltimore	+1.00	−1.00	+1.71	+5.77	+3.59	+2.10	+6.25	−3.05	+0.91	+0.14	−0.06	+0.02	+17.38
Average	+0.66	−1.14	+0.59	+3.11	+2.59	+1.13	+5.06	−0.36	+1.14	+0.31	+0.28	+0.19	+13.57
Relative humidity:													
Baltimore	−4.7	−7.4	−6.3	+0.3	+0.7	+2.9	+4.5	−2.3	+2.5	−5.5	+2.2	−7.3	......
Philadelphia	−1.1	−6.5	−4.3	−0.7	+0.5	+0.8	+3.2	−4.5	+3.8	−1.9	+4.3	−7.4	......

Average date of first "killing" frost at Philadelphia, October 29; at Baltimore, November 5. The frost of the fall of 1888 was 19 days early at Philadelphia and 14 days early at Baltimore. The average date of last "killing" frost at Philadelphia is April 4; at Baltimore, April 9. The frost of the spring of 1889 was seasonable at both places.

The departures from the normal temperature (monthly mean) during the winter of 1889-'90, as indicated by the Weather Bureau records, were as follows at the two stations nearest the orchards in question:

Stations.	Nov., 1889.	Dec., 1889.	Jan., 1890.	Feb., 1890.	Mar., 1890.	April, 1890.
Philadelphia	+2.0	+7.6	+10.8	+6.4	+0.8	+1.0
Baltimore	+1.7	+9.0	+11.0	+6.4	+0.6	+1.0
Average	+1.9	+8.3	+10.9	+6.4	+0.7	+1.0

THE SOIL CONDITIONS OF THE PENINSULA.*

Topography.—The Delaware and Chesapeake peninsula is a low, slightly undulating plain, sloping gently to the south and east. Its greatest elevation is attained about the head of Chesapeake Bay where the altitude reaches about 100 feet above tide. The peninsula is deeply invaded by wide tide-water inlets. These have low banks and wide marshes southward, but the banks increase in height northward with the increase of general elevation. The larger depressions are terraced, in some cases with several terrace plains of considerable width.

Geology.—The surface formation of the Chesapeake and Delaware peninsula is a great sheet of loams, gravels, and sands which are spread over all of the lower portions of the middle Atlantic coastal plain. Its materials were derived mainly from the crystalline and other rocks of the country westward, and were deposited in their present position during the glacial period. The formation is known to geologists as the Columbia formation. The deposits were supplied or distributed by the Susquehanna and Delaware rivers and by littoral currents. They lie on a slightly uneven surface of sands, marls, and clays—which form the substrata of the coastal plain region—and vary in thickness from 20 feet to probably 50 or 60 feet in certain localities. The loams, sands, and gravels constituting the Columbia formation in this region are irregularly distributed and give rise to every variety of soil from gravels, through sand to clay. At present the precise distribution of these soils is not known and the data is too incomplete for statement.

In the Sassafras River region the Columbia formation lies on weathered marls of Cretaceous and Eocene age which extend in a broad belt WSW. and ENE. across the peninsula. The formation here has an average thickness of about 20 feet and consists of loams, sands, and gravels. The basal beds are predominently gravelly and the upper portion is mainly a sandy loam. More or less weathered marl is included below and probably the marls are in some cases reached by the larger roots of trees. The gravels, sands, and loams are detritus of the rocks of southern and middle Pennsylvania, mainly, and were transported by the Susquehanna River in the swollen waters and submergence of glacial times. The gravels are derived mainly from quartzites and crystalline rocks and consist almost entirely of silica. The sands are mainly quartz from the crystalline rocks and are pure silica. The loams consist of admixtures of fine sand (quartz) from the crystalline rocks and of clays derived from both crystalline and slaty rocks. Portions of these materials were redeposited in the Columbia, having previously constituted other superficial formations on the coastal plain or along its western margin. The proportion of freshly derived and secondarily derived material in the Columbia deposits is not as yet known. They all had the same primary source.

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*From notes furnished by Mr. N. H. Darton, of U. S. Geological Survey.

In the Dover region the subterrain is clay and sandy clay of Miocene age, containing no appreciable amount of marl. The Columbia formation here consists of many feet of loams, sands, and gravels, with loam prevailing at the surface, excepting in certain areas where dune sands occur. These loams were in part derived from the Susquehanna Basin and in part from the Delaware Basin. The materials of both are precisely alike and have not been differentiated. The deposits were probably distributed by littoral currents and intimately intermixed.

The materials brought from Pennsylvania by the Susquehanna River were derived from the crystalline rocks of the southeast corner of the State, and from the sandstones, shales, and limestones of central Pennsylvania. The materials from the crystalline rocks are quartz grains, mica, and decomposed feldspar. The two latter contain potash. The limestone sediments are calcareous clays and flint grains. The sandstones and shales have yielded sand and clay, respectively. All are intermixed in the Columbia beds. The materials brought down by the Delaware River appear to have been derived in larger proportion from the rocks of upper Pennsylvania, which are less rich in potash. The dune sands and shore sands generally consist of quartz grains with small amounts of other insoluble minerals.

THE FOREST COVER.

The character of the original timber and undergrowth will be noted in the remarks on each orchard, and in this connection only some very general statements are necessary. The soil of this peninsula ranges from light sand to heavy clay, and the forest cover is correspondingly variable. That on the fertile loams and clays consists of the deciduous trees of the middle latitudes of the eastern United States; that on the sands consists largely of pines. Between these two sylvas are all gradations. The yellows, however, has not confined itself either to deciduous or coniferous soils. On both sides of the Sassafras River and in the vicinity of Middletown, Del., it has wrought great injury on the fertile clay loams, whereas along the banks of the Delaware River and in other places it has been equally destructive on the lighter and less fertile sands.

TIME UNDER CULTIVATION.

The upper part of the Delaware and Chesapeake peninsula, now seriously affected by yellows, has been cleared and under cultivation for periods ranging from thirty years to over two hundred.*

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*In 1668, according to Scharf, a deed was executed by an Indian conveying the high land between Tidbury branch and Five Points, on the road from Dover to Frederica, to Norton Claypole. This was described as about 3 miles from the place where Dover towne is intended to be built. Dover was projected by Penn in 1683, and land for the court-house was bought in 1694, but the town was not laid out till

As a rule, the farms along the waterways were first settled and have been under cultivation longer than those farther inland, but there is still a modicum of original timber along the ravines and on the swampy ridge in the center of the peninsula. In connection with the question of soil exhaustion, it should be noted that the lower parts of the peninsula have been settled fully as long as the upper, and that peach trees were planted on Kent Island as early as 1650, while prior to 1700 a farm in Talbot was known as "Peach Blossom," on account of its peach orchards.

STATE OF AGRICULTURE.

Previous to the development of the fruit industry, the principal crops on the upper part of this peninsula were wheat, maize, oats, hay, and tobacco, while on the lower part the principal crops were hay, tobacco, melons, and sweet potatoes.

In the early days much tobacco was raised in both of the Kents,

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1715. Prior to 1674 very little land in Kent County, Del., was taken up, but after that date settlers, principally from Maryland, began to come in rapidly and locate along the streams. In 1675 Daniel Whitely was granted 300 acres, called The Grove, lying at the head of Jones' Creek, not far from Orchard I. A tract called Amsterdam was taken up by Henry Johnson under a warrant from the court of St. Jones, March 16, 1680. This lies in the forks of Thorndyke branch and Amsterdam branch. "The greater part of this tract is now owned by James W. Green, who resides on the site of the old mansion in North Murderkill hundred." Peter Lowler lived on this tract, and died there in 16'8. His son settled on the homestead, and they had a water mill. Orchards III and XV are on this tract. The settlements in 1683 were mostly along the streams, and Towne Point, near the mouth of St. Jones' Creek, was the place where the courts were held. All of the land in the vicinity of orchards I, II, III, XIII, XIV, and XV appears to have been taken up in large tracts between 1678 and 1685. One of the earliest tracts to be located was Bombay Hook, by Peter Bayard, in 1675. The greater part of Smyrna lies in the old tract of "Gravesend," taken up by William Green in 1680. The land in upper Delaware was taken up a little earlier, Bohemia manor being settled in 1669 and New Castle, as New Amsterdam, in 1656. Wilmington was not laid out till 1735, but Fort Christiana and the Swedish village Christianholm date from a much earlier period. (Vol. 2, p. 1028.)

The oldest official record of Kent County, Md., begins with the year 1647, at which date the county embraced the whole of the west shore, the court being on Kent Island. The records of St. Paul's parish, on the north side of Chester River, begin with the year 1693. Those of Shrewsbury parish, on the south side of Sassafras River, begin with 1701. As already noted, there were some earlier settlements on Kent Island, but there were no colonists of Maryland living on the main land of the west shore until after 1650. The Tilghmans settled at the Hermitage, on Chester River, in Queen Anne, in 1660, and George Robbins settled in Talbot in 1670. The Comnegys came into Kent and settled on Chester River about the year 1672, and James and Joseph Hepbron settled on the head waters of Lloyd's Creek, in the vicinity of orchards IV to XII, between the years 1646 and 1668. In 1686 there were 401 taxable persons in Kent County, which then appears to have included Queen Anne, Caroline, and Worcester counties. In 1720 the church of St. Paul's parish rented 32 pews to 72 men.

and prior to 1720 it appears to have taken the place of money on the "east shore" in all of the ordinary transactions of life.*

The cultivation of tobacco in the upper counties is now almost completely abandoned. At present hay, corn, wheat, melons, and sweet potatoes are grown in large quantities, but the fruit industry occupies a great many farms to the subordination or more or less complete exclusion of other crops. Apples, pears, peaches, plums, cherries, grapes, and small fruits are grown in quantity. The growing of peaches was always a considerable item, but during the last thirty years it has become a special industry of large proportions. Fifteen or twenty years ago the most extensive orchards were in Cecil and New Castle, the uppermost counties. The present largest acreage is in Kent and Queen Anne, Md., and Kent and Sussex, Del. In recent years, owing largely to the encroachment of yellows on the northern end of this territory, a great many acres have been set in the lower counties on soils formerly considered less suited to peaches than to melons and sweet potatoes, or to hay and grain.

Good judges estimate the present number of bearing peach trees on this peninsula at not less than ten millions.

GENERAL REMARKS ON THE CONDITION OF THE PENINSULAR ORCHARDS.

ORIGIN.

Until recent years the nursery business has been profitable and many persons have engaged in it. The number of nurserymen and tree propagators on this peninsula is probably about thirty-five. The result of all this activity has been the very extensive planting of home-grown trees. Almost without exception the trees are on peach stock, and probably three-fourths of all the bearing orchards have been derived from local stocks and buds. In recent years a larger proportion of the trees have been procured from outside sources and localities supposed to be free from yellows, but this has not checked the spread of the disease.

In the selection of pits there has been a wide variation of practice. Some nurserymen have uniformly sought for pits from Tennessee or other localities believed to be free from yellows. Others have selected carefully from healthy peninsular seedlings. Others, with equal care, have selected from choice budded fruit growing in the vicinity, some preferring stones from Smocks and similar late sorts, some preferring the seeds of Old Mixon, Crawfords, and similar middle season varieties. Others still have taken pits from drying or canning factories, or have bought of middlemen, wherever they could find them in quantity, without reference to their origin, and this class of propagators represents a very considerable part of the whole number. Some of this class have produced trees in very large quantities.

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*In 1686 the court in Kent, Maryland, affixed the price of liquors in equivalents of tobacco, a gallon of brandy costing 100 lbs. In St. Paul's parish the first church was built in 1695, at a cost of 21,000 pounds of tobacco, and in 1714, when the community had become more prosperous, it was "ordered that the price of each pew in the new church be 1,000 pounds of tobacco." In 1712 the vestry of Shrewsbury parish agreed to give Rev. James Crawford 20,000 pounds of tobacco annually "during ye sd. Crawford's continuing amongst us." Undoubtedly the growth of so much tobacco impoverished the very fertile soil to a considerable extent.

The pits are bedded in autumn in sand and planted out in spring, or more commonly they are sowed in autumn in shallow furrows in the nursery field where the seedlings are to stand. These furrows are about three feet apart, and if the seed is good and the season favorable, the seedlings come up quite uniformly in April and stand close together in the rows. They are cultivated frequently during the growing season, and are budded, usually, in August, but sometimes in June. In the latter case there is a growth from the inserted bud the same season, in the former not until the following spring.

The varieties include all those commonly propagated by nurserymen in the eastern United States. Some are planted in great numbers, others but rarely. The experience of years has taught the growers that only a comparatively few sorts have a sufficient number of good qualities to warrant planting for commercial purposes. The early ripening varieties are usually planted on the sands, and the middle and later kinds on the loams and clays. In that part of the peninsula most affected by yellows, the orchards are composed principally of the following varieties, those considered most valuable and set most extensively being indicated by italics: *Alexander*, Beatrice, *Rivers*, Louise, *Troths*, St. John, *Crawford Early*, *Mountain Rose*, *Moores Favorite*, *Old Mixon Free*, *Stump*, *Crawford Late*, *Reeves Favorite*, Wager, Foster, Fox Seedling, *Beers Smock*, Salway, Christiana, Heath Cling, Wards Late.

ORCHARD METHODS.

The orchards are set in the fall or spring according to convenience. Usually the trees are taken from the nursery one year from the date of budding, but sometimes they are set at the end of the same season, either as June-buds or in dormant bud. Occasionally, to avoid transplanting, as a matter of economy, or for other reasons, the pits are planted and the seedlings budded in the places where the orchard trees are to stand. The field is generally carefully fitted to receive the orchard by previous cultivation. The trees are usually set 20 by 20 feet apart, but sometimes 26 by 26 feet, or as close as 15 by 17, but rarely closer, as is often the case in dryer climates where the trees make less growth, and where, as on the clay hills in middle Georgia, they are sometimes set as close as 10 by 20 feet without crowding.

The field is marked off at appropriate distances and cross marked. The trees are then set at the intersections by hand or with the use of a plow. The tops are then cut back and shaped to form trunk and branches of the desired character. Some use great care in transplanting and setting; others do not. As a rule, considerable pains is taken, and most of the trees soon recover from the shock of transplanting and make a good growth the first season.

Occasionally the trees are cultivated without crops from the start, but a majority of the growers prefer to plant maize or tomatoes between the tree rows during the first two or three seasons. So far as I have observed these crops are always grown with the use of superphosphates or complete fertilizers—more generally the latter, bought mixed from dealers—and some portion of which serves to stimulate the growth of the young trees. The cultivation is careful and quite thorough. During these years the shoots which start from the trunk are cut or pinched off, and much pains is taken to prune the trees so that they will make a well-balanced head, not easily broken by the wind. A majority of the growers cut back the trees so that they begin to branch at about 3 feet from the ground, but some are cut higher, and occasionally a man prunes his trees so as to start the main branches from close to the earth.

After the second or third year no crops are grown between the trees. Each spring the orchard is plowed, usually early in April, and sometimes, if very weedy, it receives a second plowing in midsummer, just in advance of the peach harvest. Opinions vary as to the proper depth to plow. A few growers plow deep, but the majority turn a furrow varying from 3 to 5 inches in depth, and hold that deep plowing is likely to injure the roots, which, unlike those of the pear tree, spread out for the most part nearly horizontally and at no great depth beneath the surface.

The cultivation of the orchards from April or May until midsummer is generally as thorough as for a crop of Indian corn. Most growers then allow the soil to rest and acquire a cover of grass and weeds until the following spring, but some who have been very successful are in the habit of cultivating their orchards during the late summer and the autumn months, as well as in the earlier part of the season.

After the orchards have come into bearing some growers uniformly fertilize with potash and superphosphates, or occasionally with commercial fertilizers known as "complete," but containing only a small per cent of nitrogen. Others use home-made composts and barnyard manures. Others trust almost entirely to prolonged cultivation of the soil. Recently in Delaware many have begun to plow down crops of scarlet clover (*Trifolium incarnatum*).

The common method of pruning limits itself simply to the keeping off of watersprouts and to the removal of such branches as would shade others, render the top lopsided, interfere with picking and cultivation, or subject the tree to breakage by winds or weight of fruit. Occasionally an effort is made to keep the bases of the main limbs supplied with small, fruit-bearing branches, but ordinarily not. Owing to the extent of the orchards and to the ease with which peach trees are grown, the practice of shortening in is rarely tried, and trees are never grown on stakes or trellises or against walls. The common methods of pruning can be seen well enough from the accompanying photographs.

WHEN IN BEARING.

Quite frequently, if the season is favorable, the orchard bears a profitable crop the third or fourth year, and sometimes there is a sprinkling of fruit the second season. The trees are usually of good size and in full bearing the fifth year.

THE CERTAINTY OF A CROP.

Owing to the favorable climate, it was formerly believed that a crop could be depended on two years out of three, but during recent years several things have conspired to make the crop more uncertain. In several instances spring frosts have greatly limited the yield, and in 1890 the crop was entirely destroyed by frost. The appearance of the yellows and the destructive prevalence of the peach rot (due to *Monilia fructigena*), have also tended to make the crop uncertain.

PRODUCTIVENESS.

The productiveness in eastern Maryland and Delaware, especially on the best lands, is unquestionably greater than in any other part of the country except California. In good seasons trees in full bearing often yield from three to eight baskets (five-eighths bushel), and the report of a yield of ten to fifteen baskets on old and large trees, under particularly favorable conditions, would not excite special comment. Much depends upon the variety, the character of the soil, the kind of cultivation, and the fertilization. Certain sorts like Troths, Mountain Rose, Old Mixon, and Smock are enormous bearers. Others like Reeves and Susquehanna are styled "shy bearers," old trees of large size frequently yielding not more than one or two baskets. Taking one variety with another the orchard through, two or three baskets per tree is considered a good yield.

Under the best conditions trees may be full to breaking and yet produce fruit of fine quality. In other cases, especially on light lands, the result of allowing trees to overbear is an inferior grade of fruit, smaller, of poorer quality, less brightly colored, and almost unsalable in a season of plenty. Owing to the extent of the orchards, little effort is made to produce the finest fruit, such as could readily be secured by a judicious system of thinning. Overbearing tends to inferior fruit, and to barrenness or a small crop the following year; the trees are also frequently much injured by the breaking down of limbs under the great weight of fruit, but in other respects I have been unable to see that it is specially detrimental. Certainly it has no direct or distinct connection with the appearance of yellows. This fact will come out quite clearly in the subsequent pages.

LONGEVITY.

Until the appearance of yellows, peach trees lived from twenty to forty years, depending on situation, cultivation, etc., and they still reach this age in a productive condition on those parts of the peninsula not yet invaded by this disease. In the region suffering from yellows, and especially in those parts where the disease has been present for some time, *e. g.* Cecil County, Md., and New Castle County, Del., the orchards are pretty uniformly and completely diseased before they are ten years old. Indeed, the more recently planted ones begin to show cases of yellows soon after they are set, and are frequently diseased throughout by the time they have been set six or seven years. The most of these trees grow thriftily, and for the first two or three seasons look as well as those outside of the infected districts, but then they contract the disease by dozens and hundreds, and speedily become yellow, sickly, unfruitful, and worthless.

TIME OF BLOSSOMING AND LEAFING.

In the same latitude and elevation there is considerable variation in the time of blossoming dependent on the location of the trees, those on the warm sandy lands coming into blossom several days in advance of those on the loams and clays. Sometimes late bloom is advantageous and at other times not, depending entirely on the peculiarities of the season.

The annual variation is still greater. In 1890 the orchards at Still Pond, Md., and Dover, Del., bloomed about the first of March while in 1875 and in 1881 the flowering was delayed until the first of May. In ordinary seasons the flowers open between the 15th and 25th of April, and the period of blossoming generally occupies about a week. The blossoms come out with or slightly in advance of the foliage buds, and by the time the petals have fallen the latter begin to unfold vigorously (see Plate VI, from a photo made at Still Pond, Md., April 24.) These statements apply of course only to the upper part of the Delaware and Chesapeake peninsula. In Florida the peach blossoms in January and February, in Georgia in March, in Connecticut and Ohio in May, in Maine, Canada, and northern Michigan about the first of June.

TIME OF RIPENING.

In addition to the constant and wide variation due to latitude, and the lesser variations due to seasonal influences, there are also minor variations due to exposure or difference of soil, the same variety ripening a few days earlier on warm sands than on clays or heavy loams. Ordinarily the Peento begins to come into the northern markets from Florida the last of May, Bilyeus and frost peaches from the mountains and the far north linger until late October, while the California peaches carry the season as far as Christmas. On the upper part of the Delaware and Chesapeake peninsula the very early sorts, such as Alexander, Beatrice, Rivers, and Louise, ripen in July; Troths, Old Mixon, Crawfords, and the bulk of the crop, are harvested in August; Smocks, Salway, and a number of other late kinds, carry the season to about the middle of September. Beyond this there is nothing but Bilyeu, and a few late seedlings of no commercial importance. The important canning and shipping season lasts about five weeks.

TIME OF LEAF-FALL.

For several years the writer has made a somewhat careful record of the time of leaf-fall with special reference to the effect of autumn frosts. Whatever may be the conditions in England, or in New England, in this latitude and climate there can be no question as to the maturity of the wood. The growing season extends from April to October or November and, as a rule, the shoots enter the winter in a mature, well-ripened condition, the leaves falling before the advent of severe frosts except on young and over-stimulated trees. The time of leaf-fall depends on more factors than might be supposed and varies within rather wide limits. The leaves ripen and fall early: (1) on old trees; (2) on trees which have borne a full crop; (3) on trees which have received little cultivation, or which stand in sod ground; (4) on poor soil; (5) on early varieties, and (6) on land fertilized with superphosphates and potash salts to the exclusion of nitrogen. The leaves remain green until late: (1) on young trees; (2) on trees not in bearing; (3) on late varieties; (4) on soils rich in nitrogen or to which nitrogen compounds have been added; (5) under the stimulus of late cultivation. Sometimes the leaves begin to drop in August; sometimes, especially in young and stimulated orchards, they remain green until severe frosts in November. Ordinarily, whether or not there have been frosts, the leaves fall in great numbers during the last week in September and the first two weeks in October, so that a majority of the orchards are bare or nearly bare of leaves on the advent of the first hard frosts.

The time of leaf-fall during the years 1889–1891 in the orchards under treatment is given in the general remarks under each series.

ADAPTABILITY OF CLIMATE.

The meteorological conditions of this region seem to be peculiarly favorable to the peach. The sea level, the latitude, and the almost insular condition of this region give an ample rainfall and tend to produce a mild, moist, equable climate. The winters are rarely severe, and the orchards almost wholly escape the effects of ice, snow, and low temperatures, everywhere visible in the latitude of New England. Generally, though not always, the situation is such as to protect the blossoms from late frosts. Localities farther south are certainly more subject to spring frosts, and have drier climates and inferior soils. The peach is said frequently to be a tropical fruit, but such is not the case. It belongs to the middle part of the temperate zone, and does not thrive well even in the warmest parts of the United States.

THE STARVATION HYPOTHESIS.

This explanation of peach yellows was adopted and urged by Dr. Goessmann, Prof. Penhallow, and others, first, on the interpretation of a few chemical analysis; and, second, on the results of a few orchard experiments. In Bulletin No. 9, of this division, were published some analyses made by Mr. A. E. Knorr, a Department chemist, the results of which contradicted those published by Dr. Goessmann. Knowing the tenacity with which this view has been held, and fearing that some error might have crept in unawares, it seemed best to duplicate these analyses. The next year, therefore, a very careful collection was made of diseased and healthy materials which were sent for analysis to Dr. J. F. Eastwood, formerly assistant to Prof. A. B. Prescott, of the University of Michigan, now professor of chemistry in Georgetown College, Kentucky, and known as a careful and competent chemist.

CHEMICAL ANALYSES.

The results of Dr. Eastwood's determinations will be found in the following tables. He is responsible, however, only for the ash and ash constituents, the amount of moisture having been determined in each case by the writer:

TABLE I.—*Showing green weight, dry weight, and ash in healthy and diseased peach twigs of one season's growth, the shoots having been taken from trees of bearing age.*

Substance determined.	Series I, McDaniel's orchard, Dover, Del.					
	(6) Healthy.		(7) Healthy (treated), Exp. III.		(8) Diseased (treated), Exp. III.	
	Ozs.	*Per ct.*	*Ozs.*	*Per ct.*	*Ozs.*	*Per ct.*
Fresh twigs	[1]49.125	100	[1]39.375	100	[1]46.500	100
Air-dry, 1 month in a warm, dry room	24	48.9	20	50.8	23.438	54
Kiln-dry, 3 hours	[2]23.125	47.7	[3]18.688	47.5	[3]21.813	47
Ash	1.013	2.1	1.016	2.58	.736	1.6

Substance determined.	Series III, Greene's orchard, Magnolia, Del.				Series IX, Harper's orchard, Still Pond, Md.					
	(1) Healthy.		(2) Diseased.		(3) Healthy.		(4) Healthy (treated), Exp. LXXV.		(5) Diseased.	
	Ozs.	*Pr ct.*	*Ozs.*	*Pr ct.*	*Ozs.*	*Pr ct.*	*Ozs.*	*Pr ct.*	*Ozs.*	*Pr ct.*
Fresh twigs	[4]143.25	100	[4]118	100	[5]18	100	[5]17.5	100	[5]28.25	100
Air-dry, 5½ months, in a warm, dry room	70.25	49	57.5	48.7	9.375	52.1	9.25	52.9	13.375	47.3
Kiln-dry, 3 hours	[6]67.81	47.3	[7]56.675	48	[2]8.94	49.7	[2]8.625	49.3	[2]12.59	44.2
Ash	1.987	1.4	1.228	1	.176	.98	.184	1	.153	.54

[1] Collected March 18, 1890.
[2] 86–100° C.
[3] 90–100° C.
[4] Collected November 2, 1889.
[5] Collected November 1, 1889.
[6] 90–100° C.
[7] 80–100° C.

TABLE II.—*Showing the per cent of the various inorganic matters composing the ash of the twigs mentioned in Table I.*

[Analyses by J. F. Eastwood, PH. D., Georgetown, Ky.]

Substance.	Series I.			Series III.		Series IX.		
	(6) Healthy.	(7) Healthy (treated).	(8) Diseased by yellows.	(1) Healthy.	(2) Diseased by yellows.	(3) Healthy.	(4) Healthy (treated).	(5) Diseased by yellows.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*	*Per cent.*
Silex (SiO_2)	2.66	3.95	4.01	1.39	2.41	2.97	2.24	.90
Iron (Fe_2O_3)	.51	.28	Trace.	.56	.53	Trace.	Trace.	.65
Lime (CaO)	61.21	62.14	47.61	48.85	43.68	40.54	49.05	34.75
Magnesia (MgO)	5.62	2.87	7.65	3.21	4.31	2.85	Trace.	10.23
Potash (K_2O)	15.02	15.53	20.16	28.26	32.51	30.18	25.14	30.76
Soda (Na_2O)	1.93	3.52	5.03	2.59	2.30	5.34	7.30	2.17
Phosphoric acid ($P\ O_5$)	10.63	9.02	12.63	10.45	9.29	12.00	10.52	16.86
Sulphuric acid (SO_3)	2.79	2.90	3.35	4.77	4.18	5.31	5.51	3.59
Chlorine (Cl)	.08	Trace.	Trace.	Trace.	.13	Trace.	Trace.	Trace.
Total	100.45	100.21	100.44	100.08	99.34	99.19	99.76	99.91

Concerning the materials used for these analyses, the following remarks are in order:

Series I.—All materials from this orchard were collected March 18, 1890. "No. 6, healthy," consisted of fairly representative terminal shoots of the growth of 1889, taken in about equal quantities from all parts of four untreated healthy trees near Experiment III (see p. 42). "No. 7, healthy, treated," came from several different branches of each of four healthy trees on Plat III. These trees received 13 pounds each of the Goessmann-Penhallow mixture in the spring of 1889, and the shoots had made a larger growth, but were not different in other respects from those of No. 6. "No. 7, diseased, treated," consisted of fairly representative terminal shoots in about equal numbers from various parts of four diseased trees, also on Plat III. Each of these trees became affected by yellows during the summer of 1889, *i. e.*, while under treatment, but none of them showed symptoms in all parts. Some of the twigs came from branches which seemed to be healthy, others from those which were diseased. Samples should have been collected from this orchard before the advent of spring growth, but the winter was abnormal and growth began earlier than usual, so that when the shoots were taken the blossoms had fallen (frozen) and the leaves were just beginning to push.

Series III.—The samples from this orchard were collected November 2, 1889, at the close of the season's growth. All of the shoots came from the southwest corner of the orchard and consisted of the sprouts of 1889, taken from the bases of the main limbs. "No. 1, healthy," consisted of well-matured shoots, varying in length from 15 inches to over 3 feet. The average length was about 2 feet, and very few of them bore any branches. All of the leaves had fallen with exception, occasionally, of a few on the tips, which came away at a touch. "No. 2, diseased," consisted of slender shoots, considerably branched. The spring leaves had fallen, but there were some unfolding winter buds on nearly every shoot. The average length was about 6 inches less than in No. 1. These two bundles of shoots were as nearly comparable as it is possible to get healthy and diseased shoots. They came from Beers Smock and Wilkins Cling.

Series IX.—The materials from this orchard were collected November 1, 1889, from Old Mixon trees, and consisted of shoots which grew in 1889. "No. 3, healthy," consisted of well developed trunk and limb sprouts from a single untreated tree near Plat LXXV (see p. 131). "No. 4, healthy, treated," consisted of well-developed sprouts from the main limbs of a tree on Plat LXXV, which received 3½ pounds of the Goessmann-Penhallow mixture in the spring of 1889 and showed the effect in a slightly more robust growth. "No. 5, diseased," consisted of much-branched shoots taken from the stump of a tree in the vicinity of Plat LXXV. This was a case of 1888, cut back in the spring of 1889. The shoots had dropped their spring foliage, but many of the tips were immature and winter buds were unfolding.

To assist in determining the amount of potash and phosphoric acid removed from the soil by the fruit the following analyses were made. As in the case of the shoots, Dr. Eastwood is responsible only for the ash and ash constituents, the water content having been determined by the writer:

TABLE III.—*Showing green weight, dry weight, and ash in peach stones from ripe, healthy fruit grown in Delaware.*

Condition of pits.	Series III. (9) Crawford Late, 10 pits.		Series III. (10) Old Mixon (free), 11 pits.		(12) Natural fruit. From old trees at Seaford, Del., 452 pits (2 qts).		(13) Natural fruit. From Tennessee, 482 pits (2 qts).	
	Ounces.	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*	*Ounces.*	*Per cent.*
Green	3.25	100	2.75	100	[1]63.271	100	[1]62.745	100
Air dry	[2]2.52	77	2.16	78	[3]46.875	74	[3]48.125	77
Kiln dry	[4][5]2.45	75	[5]2.09	76	[6]46.188	73	[6]46.431	74
Ash	0.0074	0.2	0.012	0.4	0.402	0.6	0.243	0.4

[1] Estimated.
[2] Eight months.
[3] Eight to nine months.
[4] On further drying 2.32 ounces = 71 per cent.
[5] Four hours, 75—90° C.
[6] Three hours, 85—95° C.

TABLE IV.—*Showing per cent of the various inorganic matters composing the ash of the peach stones mentioned in Table III.*

[Analyses by J. F. Eastwood, PH. D., Georgetown, Ky.

Substance.	(9) Crawford Late, Magnolia, Del.	(10) Old Mixon, Magnolia, Del.	(12) Natural fruit, Seaford, Del.	(13) Natural fruit, Tennessee.
	Per cent.	*Per cent.*	*Per cent.*	*Per cent.*
SiO_2			40.00	22.92
Fe_2O_3			0.44	Trace.
CaO	5.86	2.78	7.50	8.65
MgO			6.96	4.52
K_2O	26.59	17.80	20.92	32.13
Na_2O	12.76	3.53	2.81	4.40
P_2O_5	8.55	21.16	14.85	20.84
SO_3			6.98	6.00
Cl	Trace.	Trace.	Trace.	Trace.
Total	(*)	(*)	100.46	99.46

*Not enough ash for a full determination.

The flesh is believed to be scantier in seedlings than in budded fruit, but the weight of the flesh is not known for numbers 12 and 13, which were received from Charles Wright, of Seaford, Del., in a dry condition. The ratio of pits to flesh in budded fruit is shown in the following table:

TABLE V.—*Showing the proportion of pits to flesh in the best quality of budded peaches grown at Magnolia, Del.*

Variety.	Ounces.	Proportion.
(9) Crawford Late, 10 fruits (August 23, 1889):		
Pits	3.25	1
Flesh	44.75	14
(10) Old Mixon, 11 fruits (August 23, 1889):		
Pits	2.75	1
Flesh	45.25	16
(11) Crawford Late, 11 fruits (August 26, 1889):		
Pits	3.58	1
Flesh	48.42	14

TABLE VI.—*Showing the proportion of pits to flesh in the best quality of budded peaches grown at Manhattan, Kans.*

Variety.	Kilos.	Proportion.
Hales Early,* 25 fruits (August 13, 1890):		
Pits	0.0875	1
Flesh	1.7575	20
Crawford Early, † 25 fruits (August 25, 1890):		
Pits	0.125	1
Flesh	2.510	20

*A few soft fruits, but most of them hard, *i. e.*, in good condition for market. † Fully ripe.

TABLE VII.—*Showing proportion of pits to flesh in best quality of budded peaches grown at Salisbury, Md. Picked August 10, 1892.*

Variety.	Ounces.	Proportion.
Troths, 25 fruits:*		
Pits	3.531	1
Flesh	51.344	14.5
Mountain Rose, 25 fruits:†		
Pits	6.094	1
Flesh	86.531	14
Foster, 25 fruits:‡		
Pits	6.47	1
Flesh	102.16	15.8
Wager, 25 fruits: §		
Pits	4.47	1
Flesh	52.78	11.8

*Medium size; very ripe, but still eatable. Probably 350 to 375 fruits to a ⅝-bushel basket, and perhaps more. Last pickings for market some days ago.

† Average size; too ripe for shipment, but in fine condition for eating.

‡ Large, handsome fruits; on an average not more than 110 to a ⅝-bushel basket. In fine condition for eating, but too ripe for shipment. The last picking took place some days ago, and not more than a basket was to be found on the whole block.

§ Average size. In prime condition for shipment, some commencing to be soft, others still hard, but full grown and well colored. About 200 fruits to each ⅝-bushel basket.

Only one determination of the ash constituents of the flesh was made, and that is given in the following table:

TABLE VIII.—*Showing ash constituents of the flesh of Crawford Late (No. 11), handsome, fully ripe, and in good condition for eating.*

[Analysis by J. F. Eastwood, PH. D., Georgetown, Ky.]

Substance.	Per cent.
SiO_2	1.21
Fe_2O_3	0.46
CaO	4.97
MgO	4.21
K_2O	48.23
Na_2O	15.47
P_2O_5	9.82
SO_3	15.47
Cl	Trace.
Total	99.84

Nos. 9, 10, and 11 were from the orchard of James W. Green, Magnolia, Del., (Series III), and the samples consisted of ripe, healthy fruit of a fine quality. The first two were picked August 23. No. 9 was full grown and ready to pick for canning or to transport a short distance, but was not soft. No. 10 was very ripe, but still palatable. No. 11 was picked August 26, the fruits being fully ripe, very juicy, and in fine condition for eating. In case of No. 11 the following preliminary determinations were also made: Air-dry weight (eight months in a hot, dry room), pits, 3.086 ounces; flesh, 7.214 ounces. Kiln-dry weight (four hours at 75° to 90° C.), pits, 2.714 ounces; flesh, 7.085 ounces. The weight of the pits on further drying, as determined by Dr. Eastwood, was 2.455 ounces. The weight of the ash was as follows: Pits, 0.008 ounces, *i. e.* $\frac{1}{447}$ of the green weight; flesh, 0.199 ounces, *i. e.* $\frac{1}{243}$ of the green weight. The pits did not yield enough ash for a full determination, and the K_2O and Na_2O were lost by an accident. The other determined constituents were CaO, 2.00; P_2O_5, 6.36; chlorine, a trace.

Several facts are brought out quite clearly by these determinations: (1) In budded fruit the stone forms only a comparatively small part of the total weight of the fruit, *i. e.* $\frac{1}{13}$ to $\frac{1}{21}$; (2) the ash of the pit forms but an insignificant part of the whole weight of the pit, *i. e.* $\frac{1}{500}$ to $\frac{1}{166}$; (3) the ash of the flesh forms but a small part of the total weight of the flesh, *i. e.* in the one analysis only $\frac{1}{243}$; (4) the ash of both pit and flesh is relatively poor in lime and rich in potash and phosphoric acid. The flesh, so far as one analysis gives any basis for reasoning, is also rich in soda and sulphuric acid.

To determine the quantity of potash and phosphoric acid removed from the soil by a crop of fruit, it is necessary to know, in addition, the weight of the fruit, or the yield per acre or per tree. By selecting very choice specimens it was found that 100 peaches of Crawford Late, rounded up the ordinary five-eighths bushel basket. The baskets as carried to market averaged about 110 fruits. The weight of a basket of such fruit on August 23, as soon as picked, was 30 pounds, including the basket, which weighed 2 pounds.

Dr. Goessmann states that he found lime in excess and potash and phosphoric acid deficient in the diseased branches. Mr. Knorr, in diseased branches, found lime deficient and potash and phosphoric acid in excess.

Dr. Eastwood's results lend no support to the starvation hypothesis, and, in the main, confirm Mr. Knorr's analyses. In three series of analyses Dr. Eastwood found lime deficient and potash in excess in diseased branches. In the same specimens phosphoric acid was in excess twice, and in the third case, while it was slightly less abundant than in the healthy shoots used for comparison, it was present in sufficient quantity probably for the normal uses of the plant, being more abundant than in one lot of healthy specimens*. These results are in harmony with what we know of the physiological processes in plants, and, so far as they indicate any constant differences, they are to be ascribed to the less mature condition of the diseased tissues.

FIELD EXPERIMENTS.

SERIES I.—ORCHARD OF JOSEPH MCDANIEL, DOVER, DEL. (Plate XXIII.)†

This orchard was about 1½ miles north of Dover court-house, on the west side of the left highway beyond the bridge. It occupied the first field north of the farm buildings, extending along the highway about 65 rods and southwestward about one-half that distance to the ravine, covering an area of nearly 18 acres.

The trees were procured from James Alex. Fulton, of Dover, Del., and from Phillip A. Barrett, of Magnolia, Del., *i. e.*, both lots of trees came from nurseries within a few miles. Nothing is known as to manner of propagation of these trees, but presumably all were produced in the way customary in Delaware at that time, viz, with stocks derived from home-grown seeds and with buds taken from neighboring orchards.

The trees were set in the spring of 1884, and the distance apart approximated 20 by 20 feet. The total setting amounted to 1,858 trees. About the usual number of deaths resulted from transplanting and accidents of culture during the first season—altogether, probably 10 per cent. The remainder of these trees are said to have made a good growth and to have presented a thrifty, satisfactory appearance during the first two or three seasons of orchard life. The varieties planted were Mountain Rose, Old Mixon, Crawford Early, Crawford Late, etc.

The tilth was that usually given to young trees. The soil was plowed each spring and cultivated more or less carefully until July.

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* The analyses of Dr. Goessmann, Mr. Knorr, and others are given in full in Bull. No. 9, Section of Vegetable Pathology, U. S. Department of Agriculture, 1888.

† This orchard is No. 17 of Bull. No. 9.

Corn was grown between the trees in 1884, 1885, and 1886, presumably with use of phosphates, or complete fertilizers, in the hill, after the manner in Delaware. In the summer of 1887 the field was being tilled in potatoes. During the first two or three years the cultivation in orchards of maize or tomatoes with fertilizers is common in Delaware, as already noted, but potatoes are not so grown, and usually no crop whatever is cultivated between the trees after the third year. In this instance the potatoes were grown only because the orchard had given indications of speedy decay, and the owner was anxious for some kind of return from the land. The same reasons led to the cultivation of a crop of corn in 1888.

During the first three years the orchard is said to have received two very heavy dressings of stable manure, the surface being covered all over. In the spring of 1887 a ton of nitrate of soda was divided into small doses and put around the trunks of the trees. Some gas tar was also put on at this time.

Exclusive of the trees attacked by yellows or by borers, the orchard was thrifty and vigorous when examined in the summer of 1887. The trees had made a sufficient growth for their age; the foliage was abundant, smooth, and of a healthy green; the shoot-axes of the season were robust, indicating an abundant supply of plant food; and the bark of the main limbs and of the trunk was smooth and free from cracks or decay due to age, diseases, or mechanical injuries. Some of the collars and main roots were much injured by borers. Judging from the healthy trees alone and without knowledge of the nature of peach yellows, no one could have predicted the speedy decay of the orchard.

It is likely that some cases of yellows appeared in the summer of 1886, but the owner did not reside on the place, and the disease does not seem to have attracted his attention, or that of his tenant, until 1887. Then suddenly the cases were so numerous and the symptoms so pronounced that the orchard became the subject of general remark, and the belief prevailed that all of the trees would soon contract the disease and become worthless.

On the first examination the orchard contained 1,777 trees, a few of them being replants of 1885 or 1886. The total cases of yellows on September 27, 1887, amounted to 507. Upon reëxamination, August 20, 1888, there were 383 new cases, and some additional ones appeared later in the season, or during the following winter, so that when the treatments began in the spring of 1889 the orchard contained only about 850 healthy trees. Many of the cases had been vigorous and desirable trees up to the time when yellows attacked them; and even during the first year of disease some of them made a fair growth and bore considerable good foliage.

Several reasons made it desirable to experiment in this orchard, notably the large number of cases in 1887 and 1888, the belief that the disease would continue, and the marked contrast between the diseased and the healthy trees. The proximity to a much-traveled road, and the notoriety of the orchard, also influenced the selection, since favorable results would quickly become an object lesson.

The orchard bore no fruit in 1884, 1885, 1886, or 1887. It bore a moderate crop in 1888, and a very considerable part ripened prematurely.

The treatments began in the spring of 1889 when the trees had been set five years. The condition of the orchard at this time was most unsatisfactory. The trees which had remained healthy were, indeed, thrifty and fine looking, but they formed less than one-half of the orchard.

These trees had been pruned from time to time in the usual way, *i. e.*, by removing here and there an undesirable limb, but the branches had not been shortened in. The rounded tops still lacked several feet of touching the neighboring trees. The bark was smooth and handsome, even on the trunks, and the trees were in every way well grown and desirable specimens.

The diseased trees numbered more than 900, and were in all stages of decay, from cases showing slight symptoms on one limb only to bad cases affected in all parts, and already beginning to die.

Two sets of experiments were tried, (1) curative and (2) preventive. At first the disease was most prevalent on the southeast side of the orchard, but it gradually involved all parts, including a barren strip of sand noticeably free during the first two years. Owing to this fact, no areas could be found suitable for comparison with the preventive treatments, and it was necessary to be content simply with trying to keep certain trees healthy. In other words, the preventive treatments were made upon the most resistant trees, and included almost all of the solid blocks of healthy trees then remaining.

The slope and drainage are toward the south, but the field is quite level, the differences in elevation not exceeding 8 or 10 feet. In the north part of the orchard, between Plats III and IV, and VI and VII, is a slight sag where water stands for a few days or hours after many prolonged rains. The very level southeast side of the orchard also retains moisture longer, as indicated by dampness under clods in dry weather. The dryest part is a sandy ridge extending from Plats V to VII.

There is no artificial drainage, and the surface is so nearly level and so permeable that the soil does not wash, the excess of rainfall finding its way through the earth rather than over its surface. No part of the field is damp enough to be called wet except the sag (Plats XII to XIII), and this only exceptionally. The depth of the nearest well, a few rods distant, is 20 feet, the depth of the water in it being 7 feet.

The soil is a loose, shallow, sandy loam, varying in depth from 6 to 8 inches. It is inclined to yellowish from a large admixture of sand, but varies considerable in color and composition. The lightest sand is on the barren ridge; the heaviest loam, in the vicinity of Plats XIV and XV;

and the most humus, in the slight sag between the Plats III, IV and VI and VII. The field is free from stones, gravel, and rocks. The subsoil is a porous yellow clay.

The fertility, as indicated by the size of the peach trees and the growth of other crops, is good in some parts and poor in others. On the dark-colored soil in the sag corn made a tall growth and was well eared. On the sandy ridge it was stunted and destitute of ears. These two portions afford the greatest contrast. The weeds on the sandier parts are such as we commonly find on thin lands, *e. g. Mollugo verticillata.* In the sag grew the mild smart weed, *Polygonum persicaria.* On certain other parts there was a rank growth of green amaranths, indicating an abundance of nitrogen. As a whole, the field seems to be one of good capabilities, but badly treated in the past, and only moderately fertile.

The field is upland, being at least 30 feet above the bottom of the neighboring ravine and the surface of Silver Lake. It is bounded on the northwest by a level field of similar character, cultivated in wheat and corn; on the northeast by the highway, beyond which are level, open fields, one of which contained a diseased orchard in 1887; on the southeast by the farm buildings and a level pasture, and on the southwest by a ravine fringed with low trees and bushes (see background of Plate I), which, however, do not cast much shadow on the orchard.

The original timber is supposed to have been like that on similar soil in neighboring forests, *i. e.*, a moderately dense mixed growth of white and black oaks, chestnut, hickory, walnut, tulip trees, gum trees, sassafras, locust, red-bud, holly, flowering dogwood and red cedar.

It may be observed incidentally that, exclusive of the southeast side, the cases of yellows previous to the spring of 1889 were most numerous where the corn was tallest in 1888. Contrariwise, on the poor sandy ridge where the corn was only 2 to 4 feet high and almost destitute of ears the cases were least numerous, but as time went on this difference gradually disappeared, the most resistant parts of the orchard succumbing in 1889 and 1890.

It was probably cleared of forest 150 to 200 years ago, and has been fallow or under some sort of cultivation ever since, but there is no reason to suppose it was ever before planted to fruit trees or vines. As in case of most American fields under cultivation for a century or more, it is impossible to determine former treatment. Probably the field was tilled for all it would yield, with no great amount of return in the way of plant foods. On the other hand, it may have been out to commons and untilled for many years.

The old agriculture of Delaware consisted of stock-raising and grain-farming, but it was not a densely populated region, and had no railroad facilities. The most definite statement procurable is that the soil is said to have been worn out in the fifties and reclaimed in recent years by a more judicious style of farming. Corn, wheat, and clover grow well in adjoining fields, and peach trees also thrive for a few years, but then die of yellows. A younger orchard on the same farm was healthy in 1888, but is now in about the condition this then was.* In the spring of 1889 it was noted that the red clover following wheat in the field to the northeast looked remarkably well. Probably the yield of wheat in the orchard field without use of fertilizers would not exceed 10 bushels per acre.

EXPERIMENT I.

Preliminary examination (*April 20, 1889*).—North corner of the orchard; very level, but some feet higher than the adjacent highway. Soil plowed and harrowed this spring and in fair condition; loam, with more clay than most parts of the orchard. The plat borders on a meadow (wheat field of 1887) in which the clover looks remarkably well; 18 trees, 3 healthy and 15 badly diseased by yellows, but not dying.

First treatment (*April 20, 1889*).—The following mixture was evenly distributed on the surface under each tree-top, from near the trunk outward to a little beyond the spread of the branches, *i. e.*, over a radius of 6 or 7 feet:†

	Per cent.
Kieserite (50 per cent $MgSO_4$)	4
Muriate of potash (50 per cent K_2O)	24
Dissolved boneblack (16 to 18 per cent of soluble and available P_2O_5)	72
Total	100

Each tree received 13 pounds, equivalent to 1,100 pounds per acre, or really to more than twice this amount, because put upon less than one half the whole surface. Care was taken to put none nearer the trunks than 12 to 15 inches, and the soil had been heaped up toward the same by the last plowing. This mixture was sowed in still weather upon damp earth, and the soluble parts quickly moistened and deliquesced. The fertilizer was not plowed down, nor was the field harrowed immediately. The sowing was followed by a gentle rain on the night of April 21, which settled the fertilizer into the soil. On April 25-26 it rained continuously for twenty hours, and the precipitation was probably not less than 5 inches. It rained again by showers all day on the 27th.

The eight diseased trees nearest the highway were trimmed up very severely; the other seven were cut back nearly to the base of the main limbs, *i. e.*, no top was left.

First result (*August 27, 1889*).—No new cases; the three trees which were healthy remained so. No recovery or marked improvement in any of the fifteen diseased trees. One of these is now dead.

Second result (*September 24, 1890*).—The trees were dug out in the spring of 1890.

EXPERIMENT II.

Preliminary examination (*April 20, 1889*).—Situation and soil as on I, to the southwest side of which it joins; five trees; all healthy.

First treatment (*April 20, 1889*).—The same mixture as on I, but only 6½ pounds per tree. The manner of sowing and the after-treatment were also the same, except that the strong fertilizer was put close to the trunks of the two trees on the southwest side; none of the trees were pruned.

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* In July, 1892, Mr. McDaniel informed me that this orchard had been entirely ruined by yellows.

† As I shall have frequent occasion to refer to this compound, it will be designated the Goessmann-Penhallow mixture, after those who first used and recommended it.

First result (August 27, 1889).—No cases of yellows. No injury from putting the mixture close to the trunks.

Second result (September 24, 1890).—One tree gone. Presumably removed in spring of 1890, on account of symptoms of disease. The other trees healthy. These trees were dug out along with the remainder of the orchard in the spring of 1891.

EXPERIMENT III.

Preliminary examination (April 20, 1889).—Level; rather moist loam. Same remarks as under I on the condition as to cultivation; thirty-two trees, in a rectangle 4x8. All healthy, with possible exception of one tree, the second in from the left on the lower row, which was healthy in 1888, but now looks suspicious. The trees have made an excellent growth and look well, but the tops still lack 6 or 7 feet of touching.

First treatment (April 20, 1889).—The same mixture was applied as to *I*, and in the same manner and quantity, *i. e.* 13 pounds per tree, or 1,400 pounds per acre, care being taken to put none nearer the trunks than 12 to 15 inches. About one-half of the whole surface of the plat was covered, so much of the fertilizer being put under each tree that the soil was thickly covered and black. To have gone over the whole surface at this rate would have required at least 2,600 pounds per acre, and it was thought that the same results could be obtained by putting on a lesser quantity and restricting its area to the vicinity of the majority of the roots.

First result (August 27, 1889).—Ten new cases, including one doubtful. In addition, the tree which was doubtful in the spring is now plainly diseased. The trees have responded to the fertilizer, and those not diseased are covered with healthy foliage and look well.

Second result (September 24, 1890).—The doubtful tree is now badly diseased. All of the old cases are worse than last year, and there are 19 new cases, nearly all of them bad ones. One healthy tree remains, and one tree was removed in the spring by accident. This may or not have been diseased. These trees had made a thrifty, handsome growth. They still have an abundance of foliage and do not look like starved trees.

They were dug out the following winter or spring.

EXPERIMENT IV.

Preliminary examination (April 19, 1889).—Level loam, slightly lower and moister than any plat yet mentioned. The surface soil remains moist longer after rains.

Forty-two large and fine-looking trees, in a rectangle 7 by 6—eight of them diseased by yellows. Also the east and the west corner trees, healthy in 1888, now seem to be affected, or are at least doubtful.

First treatment (April 19, 1889).—The mixture, already described under I, was divided into 6½-pound portions and sowed upon the surface under the tree tops, care being taken that none touched the trunks, and that the sowings extended a little farther than the spread of the branches. The soil was moist, so that the mixture became damp and adhered closely to the earth. It was harrowed in only when the whole orchard was cultivated some days later.

First result (August 27, 1889).—Eight new cases. In addition, the east and west corner trees are now plainly diseased. The healthy trees are green and thrifty.

Second result (September 24, 1890).—The old cases are very bad—much worse than last year, and there are twenty-four new cases, including one doubtful. There is now not one healthy tree upon the plat, unless it be the doubtful one. The new cases are badly diseased.

These trees were dug out the following winter or spring.

EXPERIMENT V.

Preliminary examination (April 19, 1889).—Level, sandy soil. Higher by 5 or 6 feet than III and IV but not quite so high nor as light sand as VII, mentioned below. This plat bore remarkably poor corn in 1888—corn very scantily eared, and not one-third the size of that growing on the lower and somewhat different soil ten rods to the east—Plat XIII. This part of the orchard was sowed to red clover in the spring of 1889, and was not cultivated during the treatments. Originally thirty-five trees, in a rectangle 5 by 7, but now three vacant places, leaving thirty-two healthy trees. The three trees have been gone since prior to 1887, and probably did not have the yellows.

First treatment (April 19, 1889).—The same treatment as I and III except that only one-half as much of the mixture was used, *i. e.*, 6½ pounds per tree. It was evenly distributed upon the damp soil under the branches and quickly moistened, and deliquesced in part, sticking to the earth. It was not harrowed in immediately, but some days later when the whole orchard was cultivated.

First result (August 27, 1889).—Five cases of yellows, including one doubtful. The rest look healthy.

Second result (September 24, 1890).—The doubtful case of last year is now badly diseased. The old cases have not recovered, and there are twenty-seven new cases, most of them very badly diseased. In other words, there is not now one healthy tree on the plat. These trees have made a very good growth, and would still be considered excellent trees but for the branching, diseased water sprouts, or proventive shoots, which have broken out in all parts and fill the tree tops with a strange, pale growth of immature leaves and shoots.

All of these trees were removed the following spring.

EXPERIMENT VI.

Preliminary examination (April 19, 1889).—Level, mellow loam in the center of the orchard, near the highway. Forty-eight trees in a rectangle 6 by 8, larger than those in the east corner of the orchard. All healthy except one tree in the west corner of the plat.

First treatment (April 19, 1889).—The Goessmann-Penhallow mixture was sowed under each tree top to a little beyond the spread of the limbs, the earth farther away and that immediately around the trunks being left bare. Each tree received one-half as much as in Experiment I, *i. e.*, 6½ pounds. The earth was damp at the time of sowing and was cultivated some days later.

First result (August 27, 1889).—Six new cases. The diseased tree in the west corner shows no improvement. The trees not diseased are thrifty and bear excellent foliage.

Second result (September 24, 1890).—The condition is worse than last year. The old cases have not recovered, and there are twenty-nine new ones. Five healthy trees remain, and seven trees were dug out in the spring of 1890, at which time they probably showed symptoms of disease.

All were removed in the spring of 1891.

EXPERIMENT VII.

Preliminary examination (April 19, 1889).—Level, except the south corner, which is a gentle slope. Soil, light sand and rather barren. This plat forms part of a slight ridge, and is the highest portion of the orchard; being perhaps 8 feet above the lowest places. The southwest two-thirds of the plat was sowed to red clover in the spring of 1889. Originally thirty-six trees in a rectangle 6 by 6, but three have been gone since prior to 1887, and two in the east corner are stunted trees, and have been doubtful since 1888. The remaining thirty-one are healthy, but not as large as those on the better soil.

First treatment (April 19, 1889).—About 7 pints, 6½ pounds, of the same mixture was sowed around each tree, in the same manner and under the same conditions as in Experiment VI.

First result (August 28, 1889).—Two new cases. The two trees marked doubtful in 1888 remain so. They are not healthy trees.

Second result (September 24, 1890).—Twenty-five new cases. The trees have made a thrifty growth, but are now very badly diseased, *i. e.*, full of sickly water-sprouts and branching terminal growths like those shown on Plate VI of Bulletin 1, 1891.

Only one healthy tree remains. The two doubtful trees were dug out in the spring of 1890. Three other trees were dug out in the spring of 1890 carelessly or because they showed symptoms of disease and were thought to be outside of the plat. All of the trees were removed in the winter of 1890 or spring of 1891.

EXPERIMENT VIII.

Preliminary examination (April 18, 1889).—Level mellow sandy loam. Plowed more than two weeks ago and now beaten down by rains and moist. This last remark is applicable to all parts of this orchard. Forty trees in a rectangle 5 by 8—only 12 of which are healthy. Probably most of the affected trees became diseased in 1888, but some certainly in 1887. All of them are diseased in all parts.

First treatment (April 18. 1889).—The Goessmann-Penhallow mixture, at the rate of 700 pounds per acre, was broadcasted as evenly as possible over the entire surface, except that none was put closer to the trunks than 12 to 18 inches. The soil was moist enough for the mixture to absorb water, change color, and stick to the earth almost immediately. It was harrowed in some days later, but not until after the big rain of April 25–26.

First result (August 28. 1889).—No recoveries. Five of the diseased trees have died and there are five new cases, seven trees still remaining healthy. The latter are in a body in the west corner. The foliage of the diseased trees is yellowish or reddish and much dwarfed, but there are some indications that they have felt the effect of the fertilizer.

Second result (September 24, 1890).—All were dug out in the spring of 1890, so that the land might be put to profitable uses.

EXPERIMENT IX.

Preliminary examination (April 18, 1889).—Southwest of VIII. Same level, same soil, same cultivation. Forty-five trees in a rectangle 5 by 9. twenty-two healthy and twenty-three diseased by yellows. The trees in this corner of the orchard are rather small, but the whole orchard was set in the spring of 1884, with exception of a few replants, which are scattered about. The innermost row stands in the recently sowed red clover.

First treatment (April 18, 1889).—A little over 6½ pounds of the mixture used on I was scattered on the earth under each tree-top, but not nearer to the trunks than 1 foot, nor farther out than the spread of the limbs—*i. e.*, within a radius of 5 or 6 feet; 6½ pounds is equivalent to about 7 pints, and that amount put on this surface, which was not more than one-fourth of the whole surface, made the ground quite black, and was equivalent to 2,800 pounds per acre.

First result (August 28, 1889).—Four of the diseased trees have died and there are nine new cases. The old cases are worse than last year, but there are indications that the trees have felt the stimulus of the fertilizer.

Second result (September 24, 1890).—The trees were dug out in the spring of 1890.

EXPERIMENT X.

Preliminary examination (April 18, 1889).—Southwest of IX. Same conditions. Ten trees in a rectangle 2 by 5. Three are healthy and seven diseased. This plat is in the young clover.

First treatment (*April 18, 1889*).—The Goessmann-Penhallow mixture was broadcasted, at the rate of 700 pounds per acre, evenly over the entire surface without reference to the trees—*i. e.*, near the trunks as well as at a distance.

First result (*August 28, 1889*).—No new cases. One of the diseased trees has died, and the others show no improvement. No injury resulted from sowing the fertilizer near the trunks.

Second result (*September 24, 1890*).—All of the trees were removed in the spring of 1890.

REMARK.—In the last three experiments, commencing with the row next the highway, all of the diseased trees in the first row were cut back to the stubs of the main limbs; all in the second row were trimmed up severely, and so on alternately. This was done April 22, 1889, but made no perceptible difference in results.

EXPERIMENT XI.

Preliminary examination (*May 1, 1889*).—A level strip bordering the highway. The soil is a mellow loam on which the trees have made an excellent growth, and on which there was a good crop of corn in 1888. The surface slopes into a sag, which is continuous through the next 15 rows to the southwest, and forms the only basin in the orchard. Earth moister than on any plat previously mentioned. Forty-eight trees in a rectangle 2 by 24. Ten are healthy and the rest diseased by yellows, but not yet dying or feeble. In the autumn of 1887 twenty-one were still healthy and one was doubtful.

First treatment (*May 1, 1889*).—Strong, unleached, hardwood ashes were evenly distributed over this plat. The amount used was 3,185 pounds, or 65 pounds per tree, equivalent to 7,000 pounds per acre. The ashes were not harrowed in until some days later, but the sowing was made upon moist earth, and was followed by a rain.

First result (*August 27, 1889*).—Six new cases, including one doubtful. There are no indications pointing toward recovery. Four healthy trees remain.

Second result (*September 24, 1890*).—All of these trees were dug out in the spring of 1890. It is probable that the trees were removed before they had experienced the full effect of the ashes.

EXPERIMENT XII.

Preliminary examination (*May 2, 1889*).—A strip of loamy dark soil, parallel to XI, but separated from it by two untreated rows. This strip sags slightly from the ends toward the center, where it is now wet, the moderately loaded wagon having to be driven over it very hastily and carefully to avoid getting stuck. Even in dry weather, as already noted, the soil in this part of orchard retains moisture longer than in other parts. There are thirty-four trees in a rectangle 17 by 2; seventeen are healthy and seventeen diseased. They have made an excellent growth.

First treatment (*May 2, 1889*).—Strong, unleached hardwood ashes were evenly distributed over the entire surface. The plat received 1,634 pounds, or 48 pounds per tree, equivalent to 5,184 pounds per acre. The ground was not harrowed for some time.

First result (*August 27, 1889*).—Eleven new cases, and the old ones show no marked improvement.

Second result (*September 24, 1890*).—The row nearest the highway was dug out in the spring of 1890. On the inner row there are four new cases and no recoveries. The remaining healthy tree was dug out in the spring of 1890. This row was removed in the spring of 1891.

EXPERIMENT XIII.

Preliminary examination (*May 2, 1889*).—Dark loam and rather wet. The lowest part of the orchard and always moist. Rains have been frequent and the soil is now very wet, but no water stands on the surface. In unloading the ashes great care had to be used, with rapid driving, to avoid gettting stuck. Thirty-six trees in a rectangle 3 by 12; sixteen are healthy and twenty are diseased. The trees are large, and in 1888 the corn was tall and well eared.

First treatment (*May 2, 1889*).—Strong unleached hardwood ashes were spread evenly over the entire surface. The total weight put on was 1,620 pounds, or 45 pounds per tree, equivalent to 4,860 pounds per acre. The ashes were harrowed in some days later.

First result (*August 27, 1889*).—There are three new cases, and the old ones show no marked improvement.

Second result (*September 24, 1890*).—Twelve new cases, all badly diseased. The old cases show no signs of recovery. No healthy trees remain, the other one having been dug out by mistake, or because it showed symptoms of yellows in the spring of 1890.

All were removed in the spring of 1891.

EXPERIMENT XIV.

Preliminary examination (*May 2, 1889*).—Level mellow loam, higher and drier, with more clay than XI, XII, or XIII, but the trees have not made so large a growth. Twelve trees in a rectangle, 2 by 6. All are healthy and thrifty.

First treatment (*May 2, 1889*).—The plat received 1,087 pounds of strong unleached hardwood ashes—*i. e.*, 91 pounds per tree, equivalent to 9,828 pounds per acre. The ashes were spread evenly over the entire surface, but were not harrowed in immediately.

First result (*August 28, 1889*).—No new cases. The plat, however, is small.

Second result (*September 24, 1890*).—All but three of these trees were dug out by the owner in the spring of 1890. The remaining trees are now badly diseased by yellows, yet they have made a good growth. There is an abundance of foliage, and most of it is of good size and excellent color. Last year the ashes produced no noteworthy effect, but this year the appearance of the trees plainly indicates the effect of the fertilizer.

EXPERIMENT XV.

Preliminary examination (*May 2, 1889*).—Same level, same soil, and same general appearance of trees as on XIV, except that the second tree in from the right on the upper row appears to be diseased, although it was healthy in the fall of 1888. Twelve trees in a rectangle 2 by 6; all but one entirely healthy.

First treatment (*May 2, 1889*).—This plat received 1,017 pounds of strong unleached hardwood ashes—*i. e.*, 85 pounds per tree, equivalent to 9,180 pounds per acre. They were spread evenly over the entire surface, but not harrowed in immediately.

First result (*August 28, 1889*).—No new cases, but the tree which appeared to be diseased in the spring is now clearly so.

Second result (*September 24, 1890*).—All but three trees were dug out in the spring of 1890. Two of these are now badly diseased. They show the effect of the ashes in increased vigor of growth, color, size, and amount of foliage, but have not remained healthy, being now full of diseased water sprouts and unfolding winter buds.

All were removed in the spring of 1891.

REMARK.—At the beginning, these trees and those on XIV seemed to promise better than any others in the orchard, because they not only looked well, but had not grown very rapidly, and stood on heavier soil not given to any excess of moisture.

EXPERIMENT XVI.

Preliminary examination (*May 1, 1889.*)—East corner of the orchard, light mellow loam; very level. Forty-eight trees in a rectangle, 6 by 8. These trees are small for their age. All but one are badly diseased by yellows, some of them appearing nearly ready to die.

First treatment (*May 1, 1889*).—This plat received 3,113 pounds of strong unleached hard-wood ashes—that is, 65 pounds per tree, equivalent to 7,000 pounds per acre. They were spread evenly over the entire surface, and not harrowed in until some days later. The earth was moist at the time of the sowing, and it rained for three hours immediately after.

First result (*August 28, 1889*).—The one healthy tree has become diseased. The diseased ones show no improvement, except possibly three which, although affected in all parts and full of branching water-sprouts, are certainly provided with more abundant and greener foliage than was expected. These trees look better than the surrounding ones, but I can not tell precisely how badly affected they were last year, having kept no minute record of individual cases in this orchard. On the other hand, I did not record and do not remember any marked difference in the appearance of the affected trees in 1888.

Second result (*September 24, 1890*).—All were dug out in the spring of 1890.

GENERAL REMARKS.

1889: This orchard produced very little fruit, probably not over 100 baskets. The outer portion (see map) was cultivated several times. The inner was pastured, having been sown to red clover. The season from April to August was very rainy. The new cases—including as such ten which were doubtful in 1888; some which appeared after the examination of August 20, 1888, and prior to May, 1889, and fourteen which are now doubtful—amount to 331.

1890: Unfortunately, this orchard could not be had for experimental purposes in 1890. The owner having lost the use of the land in great part for six years, and seeing no good results from the treatments in 1889, became discouraged and dug out two-thirds of the trees in the spring of 1890. All the trees bordering on the highway and nearly all those in the southeast part of the orchard were removed at this time. The experiments were necessarily abandoned, except that I continued to watch the effect of the fertilizers on the remaining trees. In the removal of the trees not much pains was taken to distinguish between healthy and diseased, the first thought being to secure clear spaces for cultivation, even at the expense of healthy trees. Owing to this fact, some of the treatments with ashes are probably not as conclusive as they would have been.

The orchard was plowed and cultivated in the fore part of the season of 1890, and then allowed to grow in grass and weeds. Owing to general causes affecting all orchards, it produced no fruit. The general appearance was much worse than in 1889. Only a few healthy trees were left, and so much of the orchard was removed that no attempt will be made to indicate cases of 1890 on the map, except those occurring on the treated plats.

SUMMARY.

This orchard, now seven years old, is completely ruined. The yellows has been present four years, possibly five. It has borne only one crop of fruit, and that was not a full one. The orchard never overbore, and the returns from it have not been equal to the expenditures incident to its planting and subsequent management.

No trees were cured, and only three showed any signs of improvement. Moreover, certain trees which were healthy as late as August 20, 1888, and only suspicious in the spring of 1889, were not brought back to health. In all, 210 trees were under curative treatment—*i. e.*, diseased at the time the treatments began.

On the plats devoted especially to preventive treatment there were, to begin with, 216 trees, of which 201 were healthy, 9 diseased, and 6 doubtful. In the autumn of 1890, after the fertilizers had been on seventeen months, there were 173 cases and only 12 healthy trees, 31 of unknown character having been dug out in the spring of 1890. It is not likely, however, that even one-half of those dug out would have been healthy in the fall of 1890. In other words, 7 per cent were diseased or doubtful at the commencement of the treatments and 80 per cent at the end. Most of the new cases occurred in 1890, after the fertilizers had been acting more than a year and after the potash and phosphoric acid had presumably become diffused in the soil of the plats.

The remnant of the orchard was dug out in the spring of 1891. Plate I shows the nature of the field, the growth and general appearance of these trees, and the fringe of shrubs and forest trees bordering the ravine.

SERIES II.—ORCHARD OF M. HAYS, DOVER, DEL. (Plate XXIV).*

This orchard was about one-half mile south of Dover, on the west side of the highway, separated from it by a quadrangular field of about 5 acres, devoted to wheat, oats, corn, and other farm crops. It was bounded on the west by a productive pear orchard and on the north and south by wheat fields, from which it was separated by hedges of osage orange. The orchard covered an area of only about 1½ acres.

The trees were procured in great part from James Alex. Fulton, of Dover, Del. They are said to have been grown in the vicinity and budded on stock derived from Tennessee seed. Presumably they came from the same nursery as those sold to Mr. McDaniel. The Mountain Rose (thirty trees), and twelve of the Wilkins Cling came from Mr. Mifflin, of Wyoming, Del., and the Stump (twenty trees) came from Mr. Cochran, of Middletown, Del. The trees were set in the spring of 1884, and the distance apart approximated 15 by 19 feet. The varieties planted were Waterloo, Mountain Rose, Reeves Favorite, Crawford Late, Stump, Wilkins Cling, Heath, and Smock. About equal numbers of each were planted, beginning on the south side of the orchard, in the order named. The total setting amounted to two hundred and twenty trees. The selection for this orchard was made with more than ordinary care, because it was designed for family use. The few trees which died in 1884 were replaced the next spring, and the orchard was full when my attention was first called to it in the summer of 1887. Up to that time it had received careful treatment and had made a satisfactory growth. During the first three years it was cultivated in corn with the use of kainit, ashes, acidulated Carolina rock, ground bone, and Shoemaker's "Swift Sure" phosphate.

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* This orchard is No. 13 of Bull. No. 9.

The orchard bore no fruit in 1884, 1885, 1886, or 1887. In 1888 the orchards of Delaware were universally fruitful, and this was no exception. There were, however, many premature fruits.

When examined in the summer of 1887 the orchard presented an attractive appearance, and even the cases of yellows which had begun to appear were for the most part in trees that had been vigorous.

The yellows first appeared in 1887. That autumn there were thirty-six cases, and during the following year forty-seven additional ones made their appearance. Unless some restraining influence could be brought to bear, it seemed that the whole orchard must perish in the course of the next two or three years. For this reason it was believed to be an excellent opportunity to try the effect of large doses of mineral fertilizers, especially of phosphates and salts of potash.

The treatments were begun in the spring of 1889, the orchard having been set just five years. Most of the cases of 1887 had been cut back to the bases of the main limbs in the spring of 1888. None of them were dead, but many were quite sickly. On the contrary, almost all of the cases of 1888 were still quite good-looking trees, and a few of them were indistinguishable from the healthy trees on April 15, when the orchard was in blossom and beginning to put forth leaves. The healthy trees were as thrifty, well-grown, and fine-looking as any one could desire. They bore symmetrical, rounded heads, which had never been shortened in, but only pruned by the removal here and there of water-sprouts and undesirable limbs. The last pruning had been given a few weeks previous to the commencement of the treatments. The adjoining rows still lacked several feet of touching branches, but the size of the trees was such that the outermost branches of the trees in the same row nearly touched.

As noted already, this orchard stood in the midst of cultivated fields and no part of it was shaded by trees.

The field is a level rectangle. The north end slopes very gently toward the north, and the rest of the field as gently toward the west, but the variation in level is less than 5 feet. The field is a dry upland, probably 15 feet above the nearest stream, and twice that above St. Jones Creek, one-half mile to the east. It has no artificial drainage, the natural drainage through the porous earth being sufficient to remove all excessive precipitation.

The color of the dry soil is between isabella and bister, approaching the latter; when wet it is a dark bistre. It consists of 6 to 8 inches of light sandy loam, of quite uniform appearance, resting on a friable yellow clay. The color of this subsoil is isabella when dry, and between raw umber and bistre when wet. The texture of the soil is rather fine, but it is not sticky after rains. The field contains no gravel and no rocks. Excavations a few rods distant indicate that the first 8 to 10 feet of earth consists of several distinct layers of sand supporting a thin layer of clay (2 to 3 feet) on which the surface soil rests. Bricks have been made from this clay.*

The fertility of the soil is moderately good, *i. e.*, about like that of the neighboring farms. All ordinary farm crops can be grown, but fertilizers are commonly used to insure success. It has been the custom to cultivate the orchard during the early part of each growing season, and then to permit a thick cover of grass and weeds. The principal species forming this in 1890 were panic grasses (*P. sanguinale*, *P. capillare*); *Eragrostis*, ragweed, *Bidens*, pigweed, amaranths, *Xanthium*, Erigerons, asters, morning glories, etc. Judging by the growth of weeds and the appearance of the trees, the fertility was ample and about the same in all parts. The only exception was the south row, 8 to 10 feet from the well-grown osage-orange hedge. Two of these trees developed yellows in 1887, and five more in 1888, and all of them were badly dwarfed. The stunting effect of hedges has been observed in several instances, and these trees may have been starved, but the fact that the two end trees did not become stunted and remained healthy for a long time casts some doubt upon this.

This orchard is only a few miles from Mr. McDaniel's, and the original timber was probably much the same. Very fine old hollies, button woods, and tulip trees grow in the vicinity, and one of the latter is 80 feet high and nearly 6 feet in diameter with a sound trunk.

The field has probably been arable land—*i. e.*, in cultivation, pasture, or commons—for one hundred and fifty years. Dover was laid out in 1715 and this field is near enough to have probably been one of the early clearings. But the country was thinly populated for many years, and some fields have been cleared of their original timber within the memory of men.

The remarks on old methods of cultivation, and the return of plant foods to the soil, made under Series I will apply here.

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*The following strata are exposed in the cut: (1) soil; (2) subsoil, clay, 1 to 2 feet; (3) coarse sand, ochreous, compact, hard to dig, slightly suggestive of cement, 3 feet; (4) yellow, fine-grained sand, occasionally flecked with small dark-brown spots, 3 feet; (5) a fine-grained, much brown spotted sand, color nearly as dark as surface stratum, of unknown thickness; 3 and 4 are nonconformable and dip toward the east.

The field has been in the hands of the present owner since 1864, and he thinks it has been in cultivation perhaps one hundred years. After he purchased the field he began improving it with commercial fertilizers and what manure he could get from his stables and from town. It was cultivated in corn and clover with occasionally a wheat crop.

The ground was never before in fruit trees and is said to have been in good condition when the orchard was set. Consequently, good growth and fine fruit were anticipated, the more certainly because the whole county was a famous peach region, and because an orchard of several thousand peach trees on the back part of the same field, set in 1865, and separated from this one only by the pear orchard, had produced abundant crops of fine fruit for many years, and still contained about 500 bearing trees. It should be mentioned, however, that some of these old trees were then suffering from yellows and quite a good many afterwards died of the disease.

EXPERIMENT XVII.

Preliminary examination (April 29, 1889).—The south side of the orchard. Soil plowed and harrowed this spring, and in good condition. A light sandy loam, with clay subsoil; very level. On the north is a continuation of the same orchard; on the south a well trimmed osage-orange hedge separating from a wheat field, on the east a clover field, and on the west a pear orchard of bearing age. Sixty trees in a rectangle 6 by 10. Twenty-nine are diseased by yellows, ten or twelve being cases of 1887.

First treatment (April 29, 1889).—The following substances were broadcasted separately, but neither was sowed nearer to the trunks than 12 to 15 inches: Dissolved bone ash, containing 15 per cent of soluble and available P_2O_5, 800 pounds—*i. e.*, 13⅓ pounds per tree, or 2,000 pounds per acre; kainit, containing 12½ per cent of K_2O, 600 pounds—*i. e.*, 10 pounds per tree, or 1,500 per acre. The fertilizers fell upon moist earth and were harrowed in a few days later.

First result (August 24, 1889).—There are no recoveries, but only one new case has appeared.

Second treatment (April 24, 1890).—The following substances were distributed uniformly (exceptions noted) and separately over the entire surface of the plat, no care being taken to keep them away from the trunks. Dissolved bone ash (15 per cent sol. and avail., P_2O_5), 800 pounds; kainit (12½ per cent K_2O), 600 pounds.

Through an error four trees (the last in the northwest corner of the plat) received only 7 pounds each of bone ash, and all the others received 13½ instead of 13⅓ pounds, as was intended. The fertilizers fell upon moist earth not yet plowed. In the afternoon a gentle rain dissolved them into the earth nicely. It rained again throughout the forenoon of April 25, but not so as to flood or wash the soil. On Saturday, April 26, there was another light rain, and the orchard was plowed on Monday or Tuesday of the following week.

Second result (September 16, 1890).—None of the old cases have recovered, and two more are dead, making seven that have died since the fall of 1889. There are also twenty-three new cases, trees which were well nourished and handsome in 1889. Of the remaining trees, healthy in 1889, six are still healthy and one has died from some unknown cause.

With exception of the oldest cases the trees have made a large growth in spite of the disease, and no apparent evil has resulted from the very large doses of kainit. The cases in the row next to the hedge are badly stunted and bear scanty red and yellow foliage, while the ends of many of the branches are already dead. The southeast-corner tree remains, however, a very fine, thrifty, healthy specimen, and still bears many green leaves. Most of the foliage on the other rows is full grown and of good color, but the new cases are well defined and the old ones are worse than last year. On nearly all of the main branches of almost every tree there are recent diseased shoots, aggregating dozens on some trees, and these pale, feeble growths of late summer and autumn also occur in the tops of the trees at the ends of the branches.

Third result (*September 19, 1891*).—Three of the six trees which were healthy in the fall of 1890 are now diseased, and two of the other three are replants one year younger, and therefore not strictly comparable. One of the new cases is the fine tree in the southeast corner next the hedge. There are no recoveries or signs of recovery. Many are badly diseased. One is dead and three others are almost dead.

Experiment XVIII.

Preliminary examination (*April 29, 1889*).—Same orchard, same level, same kind of soil, and same tillage as Plat XVII. Forty trees in a rectangle 4 by 10, separated from Plat XVII by the same number of untreated trees (first control). Eleven trees are diseased by yellows and one is gone, leaving 28 healthy and suitable for experiment.

First treatment (*April 29, 1889*).—A mixture of 50 pounds of muriate of potash (50 per cent K_2O) and 150 pounds of dissolved boneblack (16 to 18 per cent sol. and avail., P_2O_5) was sown under the tree tops to somewhat beyond the reach of the outer limbs, *i. e.*, about two-thirds of the whole surface was covered, but none was put within 12 to 15 inches of the trunks. This gave 5 pounds per tree, or 750 pounds per acre, but if the whole surface had been covered at this rate it would have required one-third more, or 1,125 per acre. The mixture was sown upon damp earth and harrowed in a few days later.

First result (*August 24, 1889*).—The old cases have not recovered, but there is only one new case.

Second treatment (*April 24, 1890*).—The following mixture was distributed evenly over the whole surface at the rate of 5 pounds per tree: Muriate of potash (50 per cent K_2O), 50 pounds; dissolved boneblack (16 to 18 per cent sol. and avail., P_2O_5), 150 pounds. In addition, each tree also received 2 pounds of best muriate of potash sown separately. No care was taken to keep the fertilizers from touching the trunks. The conditions of soil, weather, and cultivation were the same as for the whole orchard.

Second result (*September 16, 1890*).—None of the old cases have recovered and there are 16 new ones. Only 11 healthy trees remain, and three of these are younger, *i. e.*, replants. All but one of the new cases are well defined. At this date there are more red and yellow tints in the foliage, even of the healthy trees, than on the controls at either side.

Third result (*September 19, 1891*).—Seven new cases and no recoveries. One of the replants has become affected. Four trees continue healthy, two of them being replants one year younger.

Experiment XIX.

Preliminary examination (*April 29, 1889*).—The same orchard, same soil, same tillage, and same level as Plat XVIII, or very slightly lower. Forty trees, in a rectangle 4 by 10, on the north side of the orchard, separated from Experiment XVIII by a control of the same size. Nineteen trees are diseased by the yellows. The rest are healthy.

First treatment (*April 29, 1889*).—The same amount of the same mixture as on XVIII—*i. e.*, 50 pounds of muriate of potash and 150 pounds of dissolved boneblack—was sown in the same manner. It fell upon moist earth and was harrowed in a few days later.

First result (*August 24, 1889*).—The old cases show no sign of recovery, and there is one new case. There are still 20 healthy trees.

Second treatment (*April 24, 1890*).—The whole surface received a mixture consisting of one-fourth best muriate of potash and three-fourths best dissolved boneblack. This was distributed evenly over the whole surface at the rate of 5 pounds per tree. Each tree was also given an extra 4 pounds of muriate of potash, sown separately. The soil was plowed on April 28 or 29 after some gentle rains.

REMARK.—Owing to the mild winter, the foliage is further advanced in this orchard than last year at this date.

Second result (*September 16, 1890*).—None of the old cases have recovered, two are dead, and there are 15 new cases. Only 5 healthy trees remain. The diseased trees are bad cases, much worse than last year. The foliage is red and yellowish, and the ends of many branches are dead. It is the worst-looking plat in the orchard, and the north two rows in particular are badly dwarfed.

Third result (*September 19, 1891*).—There are no recoveries, and four trees are almost dead. Two new cases have appeared, and three trees remain healthy, one of these being a replant. Eleven of the cases of 1887 were cut back that autumn or the following spring to the bases of the main limbs, but this made no well-defined difference. One healthy (?) tree supposed to be affected was cut back at the same time, and this remained sound until 1891.

FIRST CONTROL.

Preliminary examination (*April 29, 1889*).—Same orchard, same level, same tilth. Forty trees in a rectangle 4x10, between Plats XVII and XVIII. Seventeen trees are diseased by yellows, and twenty-three are healthy. The conditions of this control and the plats to either side appear to be identical. The trees are well grown on each and there is no choice.

First result (*August 24, 1889*).—One new case.

Second result (*September 16, 1890*).—The old cases have not recovered; one is dead, and there are fifteen new cases. Six healthy trees remain, two of them being replants.

Third result (*September 19, 1891*).—Six new cases, and the old ones are worse than last year.

SECOND CONTROL.

Preliminary examination (*April 29, 1889*).—Forty trees in a rectangle 4x10, between Plats XVIII and XIX. Same soil, same tillage, same level, and same general appearance of trees. Seven are diseased by yellows, and the rest are healthy.

First result (*August 24, 1889*).—Two new cases.

Second result (*September 16, 1890*).—None of the old cases have recovered, and there are nineteen new cases, one being a replant. At present this is the best looking plat in the orchard. Plats XVIII and XIX both look noticeably worse. As in the north four rows, all the cases are well marked with diseased sprouts from many limbs, but the trees do not bear so great a number of red and yellow leaves. From appearances one might suppose the fertilizers to have been put on these four rows rather than on Plat XIX.

Third result (*September 19, 1891*).—Eight new cases.

GENERAL REMARKS.

1889: The orchard was cultivated without crops during the fore part of the season, and then allowed to grass over. Only six new cases appeared this year, which is a very remarkable and unexpected falling off, corresponding to a similar one in many other orchards.

It is impossible to say that any cases are cured, but under the stimulus of the fertilizers some of them look better. On many, however, the foliage is very yellow and sickly. The healthy trees are thrifty and handsome. This was a year of scanty fruit-bearing, and the orchard produced next to nothing. The season was rainy.

1890: The orchard was tilled, without crops, in the same manner as the previous season. In the autumn it was covered by a luxuriant growth of grasses and weeds.

The orchard is worse by far than last year; over two-thirds of all the healthy trees have become affected. The yellows has increased without reference to the treatments, and there is no evidence of recovery or prevention in any part of the orchard. No fruit this year. There was a long drought in June and July. This was the most marked meteorological feature of the season.

1891: *May 5.*—The orchard has been plowed but not harrowed. The diseased trees are very sickly, and becoming worse.

May 13.—Sixteen additional cases or suspects were found, leaving only twenty-six healthy trees, and some of these are replants. None of the treated trees have recovered, and I can not distinguish between treated and untreated by any difference in the appearance of the foliage, but in many instances it is possible to tell whether the cases are of last year, or of preceding years, by the amount of vigor the trees retain. Those attacked earliest are now nearly dead. The healthy trees and sound limbs on diseased trees bear peaches which are big as the end of one's finger and growing rapidly. The orchard has been harrowed, but owing to its condition the treatments will be abandoned as hopeless. January, February, and March were very rainy months. Since the first week in April it has been dry.

July 20.—The orchard was cultivated, without crops, during the early part of the season, but is now in grass and weeds.

Most of the trees are yellow, sickly, and covered with diseased sprouts. There are many peaches and nearly all of them are premature, dark red and red-spotted. The mean flavor and inferior size of the fruit on many trees is noticeable. There is now no difference in the greenness of foliage, size of fruit, or freedom from disease on the treated and untreated plats. All are alike bad.

September 19.—The best looking portion of the orchard is the south control, No. 1. The trees are least diseased, thriftier, and bear more foliage and a greater number of normal leaves than any other plat. The worst looking plat is the north one, No. XIX, which received the heaviest extra dose of muriate of potash. The next least good-looking one is the south plat, No. XVII, dosed very heavily with dissolved bone ash and kainit. Exclusive of replants there are few healthy trees in any part, as may be seen by consulting Plate XXIV.

The orchard has not been cultivated since June and is now in tall grass and weeds. The trees capable of doing so bore a full crop of fruit. About 50 baskets were saved, and the remainder prematured and rotted.

October 24.—The entire orchard, exclusive of two healthy trees, has been cut down (see Plate II).

1892: *July 23.*—The two trees which were left now have yellows.

SUMMARY.

The cases, by years, in this orchard were as follows:

TABLE IX.—*Showing the progress of peach yellows in the orchard of M. Hays, Dover, Del. (220 trees.)*

Year.	Cases.	Per cent.
1884	0	0
1885	0	0
1886	0	0
1887	36	17.5
1888	47	22.8
1889	6	2.9
1890	90	43.7
1891	27	13.1
Total	206	94.00

Judging by the past, another year would have sufficed to affect the remaining fourteen trees. The following tables have been arranged to show the per cent of cases on the treated and untreated plats during a series of years:

TABLE X.—*Showing per cent of cases, by years, on Plat XVII, dosed with kainit and dissolved bone ash (since 1889), and on the nearest control.*

Year.	Per cent of cases.	
	Treated (60 trees).	Untreated (40 trees).
1887 1888	48.33	42.50
1889	1.66	2.50
1890	38.33	37.50
1891	5.00	17.50
Total	93.32	100.00

TABLE XI.—*Showing per cent of cases by years on Plats XVIII and XIX dosed with muriate of potash and dissolved bone black (since 1889), and on Plats 1 and 2 held for comparison.*

Year.	Per cent of cases.	
	Treated (80 trees).	Untreated (80 trees).
1887 1888	37.97	30.00
1889	2.53	3.75
1890	39.24	41.25
1891	11.39	18.75
Total	91.13	93.75

SERIES III.—ORCHARD OF JAMES W. GREEN, MAGNOLIA, DEL. (Plate XXV.)*

This orchard is on a nearly north and south county road, 7 miles south of Dover, Del., and about 2 miles west of Magnolia. It contains 30 acres of nearly level ground, only 27 of which are here considered. The trees were procured from Philip A. Barrett, of Magnolia, Del. Nothing is known as to the manner of their propagation, but there is no reason to doubt that it was with home-grown stocks and buds. Probably the buds were from Kent County orchards, and the pits, from canning or drying-houses in the vicinity.

The trees were set upon carefully-prepared soil in the spring of 1882. The distance apart approximated 20 × 20 feet, and the total setting amounted to 2,930 trees, *i. e.*, 108 trees per acre.

There were comparatively few deaths from transplanting. The young orchard grew thriftily from the start, received good care, and showed no signs of disease, becoming in the course of a few years a very uniform and fine-looking body of trees.

The orchard contained the following varieties, counting from the highway toward the east side: Beers Smock, Wilkins Cling, Fox Seedling, Christiana, Crawford Late, Old Mixon (free), Stump, Reeves Favorite, Crawford Early, and Troth.

The field was tilled in corn during the first three years, and thereafter it was plowed shallow each spring and then cultivated thoroughly until July, after which it was allowed to grass over and become weedy. Mr. Green informs me that the cultivation given to the trees was unusually good, and that he was very careful to keep them free from borers. For this purpose the trunks and collars were examined three successive years—1884, 1885, 1886—in August, but not many borers or injuries were found, so few, in fact, that the examinations scarcely repaid the trouble.

Phosphates and barnyard manures had been used on the field for other crops prior to the planting of the orchard, but none were used afterward until these experiments began. Kainit, however, was sowed broadcast, at the rate of 400 pounds per acre, in the spring of 1885, preceding the first crop of fruit.

In 1886 this orchard was generally admitted to be one of the best in the neighborhood, and the owner anticipated many valuable crops from the fact that the productive life of orchards in the vicinity had been twenty to thirty years. In the summer of 1887, when I first saw the trees, nearly all of them were green and vigorous, possessed well balanced tops, and smooth trunks and branches. This was true even of most of those in which yellows had appeared that season.

Three cases of yellows appeared in 1886 on the west side of the orchard, near the highway, but were not recognized as such until the following spring. Possibly there were a few additional cases in the back part of the orchard, but the evidence is not conclusive. Previous to this time the orchard had lost eight trees, six having been crowded out by an old cherry tree and two having disappeared from unknown causes.

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*No. 14 of Bulletin No. 9.

In 1887 the disease appeared in nearly all parts of the orchard, but the south side and the southwest and northeast corners in particular, contained a noticeably large per cent of cases, as may be seen from Plate XXV. The part freest from yellows was the middle north portion. The total new cases on September 19, 1887, was 255. The diseased peaches ripened several weeks in advance of the healthy ones, and all of them were red spotted on the skin and had red spots and streaks in the flesh. On many trees some parts of all the main limbs showed symptoms, on others the symptoms were confined to one limb or to one side of the tree.

Upon reëxamination August 18, 1888, there were 311 new cases. As in 1887, a majority of the cases occurred on the south side and in the north east corner, but they were not confined exclusively to any part of the orchard. With two exceptions, which were probably errors of diagnosis, every tree that was noted as diseased in 1887 was also diseased in 1888 and to a much greater extent, the shoot-axes and the entire foliage in many instances being dwarfed and yellow, and the trunk or main limbs being covered with diseased water-sprouts. In most cases such trees bore no fruit, but all parts were still living.

Both years the trees which were attacked had been, to all appearances, as healthy and vigorous as any in the orchard. In 1887 the disease showed a tendency to attack pairs or groups of trees, and this was also observed in 1888, together with a tendency for new cases to appear in the vicinity of old ones, but, on the other hand, some cases were isolated and remained so for several years, and the appearance of the same phenomena in other orchards renders it difficult to draw any satisfactory conclusions.

The following are the principal reasons which led to the choice of this orchard for experimental purposes: (1) Its favorable early history and thrifty appearance; (2) its situation in a region full of bearing orchards, all of which were suffering more or less from yellows; (3) the number of cases which had developed in the short space of two years and the probability of additional ones; (4) the remarkable freedom of the trees from borers, unsound limbs or injuries of any sort; (5) the fertile appearance of the soil in this and in surrounding fields; (6) the absolute control of the trees for an indefinite period, with the active coöperation of the owner.

The treatments were begun in the spring of 1889, when the trees had been set just seven years. The orchard still contained 2,350 healthy and handsome trees. The cases of yellows numbered about 574 and were in all stages of decline, some only slightly affected and others badly diseased and in marked contrast to the unaffected.

Two sets of experiments were tried, (1) curative and (2) preventive. But with one exception both kinds of trees were on the same plats and subjected to the same remedies, and the chief interest centered in the subsequent behavior of the healthy trees. At this time the orchard was still so free from yellows, the soil was so nearly uniform, and the trees were of such an even growth that it was possible to reserve untreated plats for comparison, and this was done in all cases.

The trees were on better soil and had made a larger growth than those in the McDaniel orchard, Series I. They had been pruned and shaped from time to time by the removal of undesirable branches, but were never shortened in, as recommended by Downing.

In passing, it may be mentioned that an old orchard in a level field of similar soil, to the northwest, and separated from this orchard only by the highway, bore good fruit for many years. It also contained a few cases of yellows for many years, but no particular attention was given to them because the disease did not seem to spread. In 1886 and 1887, however, there were many cases and the orchard was removed.

The orchard bore no fruit in 1882, 1883, or 1884. In 1885 the yield approximated 1,500 baskets. In 1886 there was no fruit. In 1887 the yield was between 1,500 and 2,000 baskets, many of which were premature. In 1888 the healthy trees bore a good crop, and those not too badly diseased yielded many prematures. The total crop that year approximated 6,000 baskets. The fruit from this orchard was always of good size and choice quality.

As already intimated, the field is nearly level, the variation not exceeding 8 or 10 feet. It is what would be called a level upland, although, like many Delaware fields, its elevation above the nearest streams is not more than 15 or 20 feet. The highest portion is that occupied by Plats XX, XXI, XXII, XXIII, XXVII, XXVIII, XXXVII, XXXVIII, and their controls, already noted as freest from yellows in 1887 and 1888, and consisting of somewhat lighter and drier soil than the remainder of the orchard. The flattest parts of the orchard are the south and west sides, but they are not wet. The southwest corner is a very shallow basin, with soil considerably moister and darker than that of the body of the orchard. Water does not stand here, but the earth is quite wet for some days after heavy rains. The northeast corner drains through a sag of rich-looking, dark soil, and its greater degree of moisture seems to depend on a slightly different character of the soil or subsoil rather than on a lack of surface drainage. The greater number of cases in 1887 and 1888 in these two corners and in the sag has already been noted and may be seen by examining Plate XXV. The excess of moisture was indicated not only by the soil, but also by the larger growth of the trees, and this was especially noticeable in the rich sag on the east side of the field, through which the surface drainage of the northeast corner escaped, and where nearly every tree became affected in 1887. There is no artificial drainage. The depth of the well, a few rods to the southwest, is 19 feet. It is never dry; it generally contains about 4 feet of water, but 10 feet or more in the spring.

The color of the soil when moist is a dark olivaceous brown, and when thoroughly dry a yellowish brown.* It is 6 to 8 inches in depth, quite distinct from the subsoil, and composed of fine sand, clay, and humus. With exception of one small area the field contains no stones or gravel. It cultivates into a mellow dust and is not difficult to plow even after rains.

The subsoil is yellow clay, which contains a large amount of fine sand, but is sticky when wet. It is a porous earth, which dries into hard lumps. Its color is then a yellow, slightly darker than Ridgway's clay color, and approximating his cinnamon.

The fertility of the field, as indicated by the weeds, the growth of the trees, and the quality of the fruit, is good. On neighboring fields of similar appearance I have seen good crops of tomatoes, corn, wheat, and other farm produce. For example, in 1888, the field to the south, which had been sown in winter wheat with 400 pounds of phosphate, produced 30 bushels per acre, and the yield of corn in 1891 on the field west of the orchard across the highway, with a little phosphate to each hill, was 70 bushels of ears per acre. So far as appearance goes the soil in these fields is identical with that in the orchard, and has probably been in cultivation for as many years.

It should also be mentioned that the trees of a neighboring apple orchard on this farm have reached an unusual size and are vigorous and productive.

The orchard is bounded on the west beyond the highway by a large level field devoted to clover, corn, tomatoes, and wheat, and on the south by a 30-acre field of similar character used for clover, corn, and wheat. On the east are several acres of peach trees belonging to this orchard, but not here taken into account because cut down to the base of the main limbs in 1887 to bud with a more profitable variety, and therefore subject to dissimilar conditions.† To the north is a level field of many acres, planted to peach trees in the spring of 1887 by Mr. George Gildersleve, and now developing many cases of yellows.‡

The outline of the orchard may be seen from the accompanying map. It is surrounded on three sides by a well-kept hedge of osage orange, which grows luxuriantly in this climate and suffers from no diseases.

The original timber probably consisted of holly, chestnut, walnut, oak, sweet and sour gum, tulip tree, black cherry, persimmon, sassafras, and other deciduous trees common to Delaware. The sassafras is a very common shrub in abandoned peach orchards south of Dover.

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* Ridgway's hair-brown.

† These trees were Amsdens, and have been equally subject to yellows.

‡ In 1892 probably 400 out of about 3,000.

One very large sweet cherry shades a diameter of 60 feet in the center of the orchard, and a large sassafras stands in the southeast part, on the twelfth control. Similar soil in the vicinity bears some of the largest sassafras trees I have ever seen, one of them being 4 feet in diameter at 4 or 5 feet from the ground. The under shrubs and small trees in the neighboring forests consist of chinquapin, sassafras, and persimmon bushes, red-buds, flowering dogwood, etc.

It is uncertain when the field was cleared, but it has probably been under cultivation at intervals for one hundred and seventy-five years, and possibly longer (see footnote p. 25).

The old time methods of tillage were probably neither better nor worse than those generally prevalent in the eastern United States. The field was never before in peach trees.

The farm came into the hands of its present owner in 1869, and at that time this field was unfenced and grown up to sassafras bushes, being considered too poor to till. From that time until the setting of the orchard it was tilled in red clover and various grain crops. The methods practiced by Mr. Green are in general such as modern notions of agriculture have indicated, *i.e.*, rotation of crops, with the use of animal manures, clover, and commercial fertilizers.

The entire country is now under cultivation except the borders of streams, and some flat, frosty woodlands. The principal crops, aside from peaches, are pears, apples, cherries, grapes, and small fruits; wheat, corn, clovers, tomatoes, melons, and sweet potatoes. Stock-raising is of minor importance.

The soil of the country, and even that of adjacent farms, is quite variable, ranging from light sand to stiff loam. The sandy land best adapted to peaches predominates in the vicinity of Magnolia, and, consequently, there are many hundred acres of bearing orchards within a few square miles.

EXPERIMENT XX.

Preliminary examination (April 30, 1889).—Level, sandy loam; highest portion of the orchard; soil recently plowed and free from weeds. Sixty trees in a rectangle 6 by 10. These trees have made a good growth, and all but four are now healthy, the latter having become diseased in 1888.

First treatment (April 30, 1889).—The following mixture was applied:

	Pounds.
Kieserite (50 per cent $MgSO_4$)	7.5
Muriate of potash (50 per cent K_2O)	45.0
Dissolved bone black (16 to 18 per cent of soluble and available P_2O_5)	135.0
Total	187.5

This fertilizer, which is the Goessmann-Penhallow mixture, was sowed evenly under each treetop as far out as the limbs extended, but care was taken to put none within 15 to 20 inches of the trunks lest they might be injured by the strong fertilizer. The sowing was equivalent to 337½ pounds per acre, but only about two-thirds of the whole surface was covered. *i. e.*, the areas drawn upon most heavily by the roots of the trees. The fertilizer was sowed upon moist earth, and the whole orchard was harrowed a few days later.

First result (*August 22, 1889*).—Two new cases. No noticeable improvement in the old cases. The trees on the north end of this plat now seem a very little smaller than those on the south end, or on the Plats XXI, XXII, and XXIII.

Second treatment (*April 18, 1890*).—The same mixture was used as for the first treatment, and the same amount per tree, *i. e.*, 3½ pounds. It was sowed evenly over a diameter equal to the spread of the branches, *i. e.*, equal to about three-fourths of the whole surface; but, by an oversight, two trees at the east end of the north row received none. The fertilizer was harrowed in.

Second result (*September 16, 1890*).—The old cases show no signs of recovery. There are only two new cases. Neither is on the part missed in sowing.

Third treatment (*May 7, 1891*).—The plat received 187½ pounds of the same mixture as in 1889 and 1890. This was weighed out for each tree, as customary, the south thirty trees receiving 3.6 pounds and the north thirty receiving proportionally less than the usual amount. The mixture was distributed by hand, outward from each trunk nearly as far as the spread of the branches, *i. e.*, over about two-thirds of the surface of the plat. It fell upon plowed earth and was turned down 3 to 5 inches on May 9, in dry weather.

Third result (*September 16, 1891*).—No recoveries; old cases very badly diseased, and twelve new cases, three-fourths of which are on the south half of the plat, which received the most fertilizer, and where the trees were also noted as being largest.

Fourth result (*July 21, 1892*).—Thirty-two new cases.

EXPERIMENT XXI.

Preliminary examination (*April 30, 1889*).—Same level, or only 1 to 2 feet lower, and very slightly moister than XX, same soil and same tillage. The plat contains sixty trees in a rectangle 6 by 10, and joins Plat XX on the south. There are only four diseased trees, one of which became affected in 1887 and the rest in 1888. The healthy trees are of the same general appearance as on Plat XX, *i. e.*, very thrifty and satisfactory.

First treatment (*April 30, 1889*).—This plat received 375 pounds of the same mixture as Plat XX, *i. e.*, twice as much. This was broadcasted evenly over the whole surface, except that none was put nearer to the trunks than 20 inches. Each tree received 6¼ pounds, equivalent to 675 pounds per acre.

First result (*August 22, 1889*).—Ten new cases, all on the south half of the plat. The old cases are worse than last year.

Second treatment (*April 18, 1890*).—The same quantity of the mixture was sowed as in 1889, exceptions noted, under the branches of each tree, covering about four-fifths of the whole surface. The mixture fell upon moist earth and was harrowed in a few days later. By an oversight three trees on the east end of the seventh row, counting from the south, were left untreated, and the 19 pounds which they should have received was sowed north and south on the east side of the plat in the middles between the first, second, and third rows.

Second result (*September 16, 1890*).—All of the old cases are worse than last year, and there are twelve new cases, none, however, on the small strip accidentally missed in the sowing.

Third treatment (*May 7, 1891*).—Each tree received the same quantity of the same mixture as in 1889 and 1890. About two-thirds of the whole surface of the plat was covered; that is, the portions nearest to the trunks of the trees and most drawn upon by the roots. This mixture contained some slight impurities of an acid taste and a brick-red color. It fell upon plowed ground, and was turned under 3 to 5 inches on May 9.

Third result (September 16, 1891).—The old cases are worse than ever, and there are seven new ones. One-half of the trees have become diseased since the experiment began. The diseased trees have a large amount of red color in their foliage. To a lesser degree the same is true of a large part of all the affected trees in this orchard. The red color is certainly more noticeable than last year.

Fourth result (July 21, 1892).—There are 24 new cases.

EXPERIMENT XXII.

Preliminary examination (April 30, 1889).—Same level, same soil, same tillage, and same size and general appearance of the trees as on Plat XX, from which this plat is separated by five rows of untreated trees. The plat contains sixty trees in a rectangle 6 by 10. Only three are diseased, and these became affected in 1888.

First treatment (April 30, 1889).—The following mixture was distributed evenly under the branches of each tree outward, so that the peripheries of the sowings touched, or nearly touched, but none was put nearer to the trunks than 15 to 20 inches:

	Pounds.
Kieserite (50 per cent Mg. SO_4)	7.5
Muriate of potash (50 per cent K_2O)	90.0
Dissolved bone black (16 to 18 per cent of soluble and available P_2O_5)	135.0
Total	232.5

It will be observed that this mixture differs from that put upon Plats XX and XXI only in containing twice as much muriate of potosh (KCl). Each tree received 3.87 pounds, equivalent to 418 pounds per acre of 108 trees.

First result (August 22, 1889).—Five new cases, all of which are on the north end. The old cases are worse than last year.

Second treatment (April 18, 1890).—The same amount of the same mixture as in 1889 was sowed evenly under the branches, so that about four-fifths of the whole surface of the plat was covered. Each tree received the same amount, *i. e.*, 3.87 pounds. The mixture fell upon earth nearly dry and was worked into the soil a few days later, when the whole orchard was carefully harrowed.

Second result (September 16, 1890).—Only three new cases. None of the old cases give any indications of recovery.

Third treatment (May 7, 1891).—The same quantity of the same mixture as in 1889 and 1890 was sowed evenly under the branches of each tree so as to cover about three-fourths of the whole plat and reach most of the roots. The fertilizer fell upon plowed earth and was turned under 3 to 5 inches on May 9. The controls were not replowed at this time, but the whole orchard was harrowed a few days later.

Third result (September 16, 1891).—Twenty-six new cases, *i. e.*, nine times as many as last year, and the old ones are worse than in 1890. Only twenty-three healthy trees remain.

Fourth result (July 21, 1892).—There are seventeen new cases.

EXPERIMENT XXIII.

Preliminary examination (April 30, 1889).—Same level, same soil, same tillage, and same size and general appearance of the trees as on Plat XXII, which joins it on the north. The plat is separated from XXI by a rectangle of 50 (5 by 10) untreated trees. This plat contains sixty trees in a rectangle 6 by 10. Ten are diseased by yellows, three being cases of 1887, and the rest cases of 1888. The unaffected trees are thrifty and handsome.

First treatment (*April 30, 1889*).—This plat received a double dose of the same mixture as the preceding, *i. e.*, 465 pounds, consisting of kieserite, 15 pounds; muriate of potash, 180 pounds, and dissolved bone black, 270 pounds. This fertilizer was scattered as usual in a circle evenly under the branches and out far enough to touch or nearly touch the sowings made under neighboring treetops, but none was put within 15 to 20 inches of the trunks. Each tree received 7¾ pounds, equivalent to 837 pounds per acre.

First result (*August 22, 1889*).—Three new cases. The old ones show no improvement.

REMARK.—There is no doubt that the trees on these four plats have felt the stimulus of the fertilizers, and the amount of certain ingredients was probably excessive, as shown by the fact that at this time the foliage, even of healthy trees, contains more red and yellow than usual, or than shown by healthy trees in other parts of the orchard.

Second treatment (*April 18, 1890*).—The same quantity of the same mixture as in 1889 was applied in the same way, covering about nine-tenths of the whole plat. As in nearly all of these experiments, the mixture was weighed out separately for each tree. It was sowed carefully and harrowed in a few days afterward. No special pains was taken to keep the fertilizers away from the trunks, the experiments of 1889 having shown that no injury resulted from contact with the bark.

Second result (*September 16, 1890*).—Nineteen new cases, *i. e.* six times as many as last year. All the old cases look worse than last year. As in 1889, the trees on the treated Plats XX–XXIII have matured their shoots early and now show an unusual amount of red and yellow foliage. There can be no question as to the trees having felt the effects of the fertilizers. They show it plainly.

Third treatment (*May 7, 1891*).—This plat received 465 pounds of the same mixture as that used in 1889 and 1890, *i. e.* 7¾ pounds per tree, or 837 pounds per acre. About three-fourths of the whole surface of the plat was covered as evenly as possible, in circles extending outward from each trunk far enough to include most of the roots. The fertilizer fell upon the earth which had been plowed in April. It was turned under 3 to 5 inches on May 9.

Third result (*September 16, 1891*).—Twenty-three new cases. The old cases have not recovered and most of them are very sickly, foliage dwarfed and yellow or reddish, and twigs stunted or dead. Nine-tenths of the trees have become diseased since the treatments began. Only five healthy trees remain.

Fourth result (*July 21, 1892*).—There are five new cases.

THIRD CONTROL.

Preliminary examination (*April 30, 1889*).—A rectangle of one hundred trees, 5 by 20, separating Plats XX and XXI from XXII and XXIII. The surface configuration, the character of the soil, and the health and general appearance of the trees are the same as on the four treated plats. The south half is 1 to 2 feet lower than the north part, *i. e.* like XXI. Of these trees four became diseased in 1888, two in each block of fifty, and the rest are now healthy.

First result (*August 22, 1889*).—No new cases. The old cases have not recovered and do not differ in appearance from those on the treated plats.

Second result (*September 16, 1890*).—The old cases have not recovered, and there are fifteen new ones, nine of them being on the north half of the plat. The trees which are not diseased present an excellent appearance.

Third result (*September 16, 1891*).—Forty-one new cases, corresponding to a general increase of cases in all parts of the orchard. The old cases are much worse than last year, but are not different from those on the treated plats. The healthy trees still look well.

Fourth result (*July 21, 1892*).—Thirty-one new cases.

FOURTH CONTROL.

Preliminary examination (April 30, 1889).—A plat of sixty-one trees in a narrow strip on the east side of XXII and XXIII, slightly less comparable than the preceding control. This bears five diseased trees, four being cases of 1888, and the other a case of 1887.

First result (August 22, 1889).—Four new cases.

Second result (September 16, 1890).—Eight new cases. None of the old ones have recovered.

Third result (September 17, 1891).—Twenty-six new cases.

Fourth result (July 21, 1892).—Thirteen new cases.

FIFTH CONTROL.

Preliminary examination (April 30, 1889).—A triangular strip north of the third control, and of Plats XX and XXII. This contains seventy-eight trees, but is thought to be less suitable for comparison than the third control, because the soil slopes to the north and the vegetation seems to be slightly different. The plat contains eight diseased trees, all of which are cases of 1887.

First result (August 22, 1889).—Eight new cases.

Second result (September 16, 1890).—Ten new cases, and no recoveries.

Third result (September 16, 1891).—Eighteen new cases, four of which are trees into which water containing bruised fragments of diseased leaves and stems, was inserted in the spring of 1891.

Fourth result, July 21, 1892.—Twenty new cases.

Remarks on Plats XX–XXIII and their controls.

This trial of the Goessmann-Penhallow mixture was begun under what appeared to be very favorable circumstances. The results are summarized in the following tables:

TABLE XII.—*Showing per cent of cases by years on four plats dosed with the Goessmann-Penhallow mixture (since 1889) and on three adjacent untreated plats in the orchard of James W. Green, Magnolia, Del.*

	Treated plats (240 trees).					Untreated plats (239 trees).			
	XX (60 trees).	XXI (60 trees).	XXII (60 trees).	XXIII (60 trees).	Average.	Average.	1 (100 trees).	2 (61 trees).	3 (78 trees).
1882	0.	0.	0.	0.	0.	0.	0.	0.	0.
1883	0.	0.	0.	0.	0.	0.	0.	0.	0.
1884	0.	0.	0.	0.	0.	0.	0.	0.	0.
1885	0.	0.	0.	0.	0.	0.	0.	0.	0.
1886	0.	0.	0.	0.	0.	0.	0.	0.	0.
1887	0.	1.7	0.	5.	1.7	4.	0.	1.6	10.3
1888	6.6	5.	5.	11.6	7.	3.9	5.	6.6	0.
1889	3.3	16.6	8.3	5.	8.3	5.6	0.	6.6	10.3
1890	3.3	20.	5.	31.6	14.7	13.6	15.	13.1	12.8
1891	20.	11.6	43.3	38.3	28.3	35.8	41.	43.3	23.1
1892	53.3	40.	28.3	8.3	32.5	26.	31.	21.3	25.6
Total	86.5	94.9	89.9	100.	92.5	89.	92.	92.5	82.1

From this table it will be seen that there have been most cases on the plat that received most fertilizer (XXIII), and fewest on that which received least (XX), but many on each of them. There was a great increase of the disease the third and fourth years on all of the controls, and on three of the four treated plats, the other one having suffered less in 1891 than in 1889, 1890, and 1892. A comparison of the averages shows an increase of the disease year after year, up to 1892, both on treated and untreated, then a slight decrease of cases on the untreated. Some cases appeared each year on each of the four treated plats, but in 1889 there were none on the third control, although it contained 100 trees. This, however, is not as exceptional as would seem at first, for by taking the nearest 100 treated trees in the most favorable manner—*i. e.*, two rows to the east and three rows to the west of the control—we have for a series of years the following comparison:

TABLE XIII.—*Showing cases, by years, on the third control and on the nearest 100 treated trees.*

Year.	Plats.	
	Untreated.	Treated.
1889	0	7
1890	15	12
1891	41	33
1892	31	34
Total	87	86

In passing, it may be noted that if the treatments had been confined to two years and restricted to two plats (XX and XXII) without careful control experiments, the very fallacious inference might have been drawn that the treatments prevented the increase of the disease. The contradictory results obtained on these two plats the third year and on XXI and XXIII the first and second year emphasize the necessity for numerous experiments and great caution in drawing conclusions.

EXPERIMENT XXIV.

Preliminary examination (*April 29, 1889*).—This plat is south of XXI and nearly level; but on the west end there is a gentle decline into a slight bottom, 3 to 4 feet lower. Soil, a sandy loam, recently plowed, and free from weeds.

There are eighty trees in a rectangle 4x20. All are healthy but four, which became diseased in 1888.

The east portion, embracing not quite half of this plat, is 2½ to 3 feet higher than the west part, and the soil is somewhat lighter and drier. The trees also are not quite so large. This change begins 10 rows in from the west on the north side, and 14 rows in from the west on the south side (see map). West of a line drawn diagonally across the plat between these points the surface is still entirely moist from heavy rains, but on the east side the surface begins to be dry in places.

First treatment (*April 29, 1889*).—The following mixture was put upon this plat:

	Pounds.
Nitrate of soda (15 per cent N.)	120
Muriate of potash (50 per cent K_2O)	120
Dissolved bone black (16-18 per cent soluble and available P_2O_5)	280
Total	520

This mixture, at the rate of 6½ pounds per tree, or 700 per acre, was sown evenly under the tree tops and beyond the spread of the branches so that nearly the whole surface was covered. It was harrowed in.

First result (*August 22, 1889*).—Only one new case. No marked improvement in the old cases.

Second treatment (*April 19, 1890*).—The same quantity of the same mixture as in 1889 was distributed evenly under the branches of each tree. In this way about three-fourths of the whole surface of the plat was covered. The fertilizer fell upon nearly dry earth, and was harrowed in a few days later.

Second result (*September 16, 1890*).—The old cases have not recovered, and there are forty-four new cases, including one doubtful. This result indicates that the absence of cases last year was not due to the treatment. The fertilizer has produced a marked effect. In comparison with the controls the trees have made more growth and the leaves are more abundant, larger, and darker green.

REMARKS.—The cases in 1890 were so numerous that the treatment was abandoned; but, owing to the amount of potash and phosphoric acid still presumably unused and within reach of the roots, the observations were continued.

Third result (*September 16, 1891*).—The tree which was doubtful is now plainly diseased. The old cases are much worse than in 1890, and there are twenty-four new ones. Only seven healthy trees remain.

Fourth result (*July 21, 1892*).—Six new cases.

SIXTH CONTROL.

Preliminary examination (*April 29, 1889*).—This plat consists of one hundred trees in a rectangle 5 by 20, bordering Plat XXIV on the north. The soil, tillage, surface, configuration, and general appearance of the trees are the same as on XXIV. All are healthy except one tree, which became diseased in 1888.

First result (*August 22, 1889*).—Four new cases, including one which is doubtful.

Second result (*September 16, 1890*).—Twenty-three new cases; *i. e.*, only a little over one-half as many as on Plat XXIV, or less than one-third as many, if we include in this comparison only the nearest eighty trees. The doubtful tree is now plainly diseased, and there have been no recoveries.

Third result (*September 16, 1891*).—Thirty new cases. Forty-two healthy trees remain; *i. e.*, seven times as many as on Plat XXIV, or six times as many if we include a like number of trees, the nearest eighty.

Fourth result (*July 21, 1892*).—Forty-two new cases.

SEVENTH CONTROL.

Preliminary examination (*April 29, 1889*).—This plat consists of eighty trees in a rectangle 4 by 20, situated directly south of XXIV, and between that plat and XXV. The soil, tillage, surface configuration, and general appearance of the trees are the same as on Plat XXIV. Fifteen trees are diseased by yellows, three of which became affected in 1887 and the others in 1888. The rest are healthy and fine-looking.

First result (*August 22, 1889*).—Ten new cases, including one doubtful. The excess of cases on this plat over the number on XXIV is perhaps to be explained by the relatively larger number which appeared in 1888 and the tendency of new cases to appear in the vicinity of old ones. The old cases are not worse than those on XXIV and XXV.

Second result (*September 16, 1890*).—The doubtful case is now diseased, and there are twceny-nine new cases. The old cases are worse than last year, but not worse than on XXV.

Third result (*September 16, 1891*).—Twenty-three new cases. Three healthy trees remain, the final result being only slightly different from that on XXIV.

Fourth result (*July 21, 1892*).—Two new cases.

EXPERIMENT XXV.

Preliminary examination (*April 29, 1889*).—Surface, level; soil, sandy loam; tillage, the same as in other parts of the orchard. The west portion of this plat is moister and there the trees have made a larger growth, but all of the healthy trees are thrifty. Eighty trees in a rectangle 4 by 20. One-fourth are diseased by yellows, nine being cases of 1887 and the others cases of 1888.

First treatment (*April 29, 1889*).—The following mixture was sowed quite evenly as far out from each stem as the branches extended, but none was put nearer to the trunks than 12 to 15 inches:

	Pounds.
Nitrate of soda	120
Muriate of potash	120
Total	240

The mixture set in the bag and had to be crushed before using. Each tree received 3 pounds, equivalent to 324 pounds per acre, so distributed as to reach the roots as speedily as possible. This mixture is identical with that on Plat XXIV, except that the dissolved bone black is excluded.

First result (*August 22, 1889*).—Sixteen new cases, and no improvement in the old ones.

Second treatment (*April 19, 1890*).—This plat received the same treatment as last year, but the compounds were sowed separately. About three-fourths of the whole plat was covered in the same manner as previously, except that three small trees, budded on plum roots and set in the place of three diseased ones on the north part of the west row, received only the muriate. The fertilizers were harrowed in some days later.

Second result (*September 16, 1890*).—None of the old cases have recovered, and there are thirty-eight new cases, including one doubtful. The trees have made a big growth, and the foliage is more abundant and darker green than on the controls. The fertilizers have produced an easily visible effect, but there are more than twice as many cases as last year, and nearly one-third more than on the seventh control. Only six healthy trees remain.

Remark.—The treatment was abandoned.

Third result (*September 16, 1891*).—Six new cases. No healthy trees remain, and the entire eighty are valuable only for fuel.

EIGHTH CONTROL.

Preliminary examination (*April 30, 1889*).—A plat of sixty trees in a rectangle 3 by 20, situated between Plats XXV and XXVI. The soil, tillage, and configuration of the surface are similar. The trees are also of the same age, size, and general appearance. Ten of these trees became diseased in 1887 and twenty-two in 1888. The remaining twenty-eight are healthy.

First result (*August 22, 1889*).—Nine new cases. The old cases are much like those on XXVI. None have recovered.

Second result (*September 16, 1890*).—Seventeen new cases. The old cases continue. Two trees are yet healthy.

Third result (*September 16, 1891*).—The last healthy trees have succumbed, and the entire block is good for nothing but fuel.

EXPERIMENT XXVI.

Preliminary examination (*April 30, 1889*).—This plat is on the south side of the orchard next to a productive wheat field, from which it is separated by a vigorous but well-trimmed hedge of osage orange. Very level; soil, sandy loam, recently plowed and free from weeds.

Eighty trees in a rectangle 4 by 20. All have made a large growth, but forty-seven are badly diseased, sixteen of these having succumbed in 1887, and twenty-nine in 1888, and two in the winter of 1888–'89.

First treatment (*April 30, 1889*).—The following mixture was used:

	Pounds.
Muriate of potash (50 per cent K_2O)	120
Dissolved bone black (16 to 18 per cent soluble and available P_2O_5)	280
Total	400

This was scattered over the whole surface. Most was put under the branches, but none within 15 inches of the trunks. Each tree received 5 pounds, equivalent to 540 pounds per acre. Exclusive of the nitrate of soda this mixture is the same as that put on Plat XXIV.

First result (August 22, 1889).—Three new cases, including one doubtful. The old cases show no signs of improvement except that one, which was marked diseased in 1888, is now entirely healthy. This was probably an error in diagnosis.

Second treatment (April 19, 1890).—The same quantity of the same mixture as in 1889 was distributed under each tree, except that four trees on the west end (young peach on plum roots planted in place of diseased trees) received only 1½ pounds each, and the others proportionately more. About four-fifths of the whole plat was covered—*i. e.*, the parts most drawn upon by the roots of the trees. The fertilizer was harrowed in.

Second result (September 16, 1890).—Thirty new cases, *i. e.*, ten times as many as last year. No healthy trees remain. The trees on this plat are now badly affected—so yellow, stunted, and covered with sprouts, that little if any difference is apparent between them and the trees on the nearest control. The fertilizers have not checked the spread of the disease, and have not improved those already diseased.

REMARK.—January 28, 1891. All the trees have been cut down.

Remarks on plats XXIV-XXVI and their controls.—Potash entered into all of these treatments. They were undertaken, in part, to determine whether the presence or absence of nitrogen and phosphoric acid would exert any appreciable influence on the result. The following table gives the per cent of cases by years on the treated and the untreated plats.

TABLE XIV.—*Showing per cent of cases by years on three treated and three untreated plats in orchard of James W. Green, Magnolia, Del., the treatments having begun in the spring of 1889.*

Year.	Treated plats (240 trees).				Untreated plats (240 trees).			
	XXIV (80 trees). Complete fertilizer.	XXV (80 trees). Do. —P_2O_5.	XXVI (80 trees). Do. —N.	Average.	Average.	6 (100 trees).	7 (80 trees).	8 (60 trees).
1887	0.0	11.3	20.	10.4	7.	0.0	3.8	16.7
1888	5.	13.8	38.8	19.2	17.6	1.	15.	36.7
1889	1.3	20.	3.7	8.	10.5	4.	12.5	15.
1890	55.	47.5	37.5	46.6	29.2	23.	36.3	28.3
1891	30.	7.5	....	12.5	20.7	30.	28.8	3.3
1892	7.5	....	....	2.5	14.8	42.	2.5	....
Total	98.8	100.	100.	99.2	99.8	100.	98.9	100.

EXPERIMENT XXVII.

Preliminary examination (April 23, 1889).—This plat begins 11 rods east of the sixth control, *i. e.*, just beyond the middle of the orchard, and extends nearly to the east end of the orchard. The soil is loam and nearly level, but the middle portion of the strip is a little higher than the east or west end, perhaps 4 to 6 feet. The earth was plowed recently and is in good condition.

Sixty-six trees in a rectangle 3 by 22, not quite so large as those in the southwest corner of the orchard, but healthy and thrifty. The largest are on the west end. There is no case of yellows either on the plat, in the first row to the north, or the first three rows to the south.

First treatment (April 23, 1889).—Muriate of potash (50 per cent K_2O) was distributed evenly over the entire surface except that none was put nearer to the trunks than 12 to 15 inches. Each tree received 2 pounds, equal to 216 pounds per acre. It fell upon plowed earth and was not harrowed in immediately, but after a few days.

First result (*August 22, 1889*).—One case has appeared. The trees look healthy, but the foliage does not differ in appearance from that on the controls to either side. In this particular the contrast between this plat and XXIX, treated with nitrate of potash, is very marked.

Second treatment (*August 26, 1889*).—Each one of the thirty trees on the east part of this rectangle received 2 pounds of muriate of potash. It was broadcasted and fell evenly upon level ground covered with low grass and weeds, but was not harrowed in. The west part received no treatment.

Third treatment (*April 19, 1890*).—One hundred and thirty-two pounds of muriate of potash was divided into equal parts and evenly distributed under the branches of each tree, covering in this way about three-fourths of the surface of the plat. It was harrowed in.

Second result (*September 17, 1890*).—Fourteen new cases, including one doubtful. Six of the new cases are on the east end, which received the extra autumn treatment. The one case of last year has not recovered, but is worse. As in August, 1889, this plat is not distinguishable from the controls to either side. The trees on each have made a good growth and the foliage is now beginning to take on autumn tints and to fall.

Fourth treatment (*May 7, 1891*).—Each tree received two pounds of muriate of potash (50 per cent K_2O), sowed in circles around the trunks as evenly as possible, so as to cover about two-thirds of the whole surface. It fell upon plowed ground, which was again plowed May 9 to a depth of about 4 inches. The foliage was growing rapidly. Most of the peaches had shed the cap and were as big as filberts.

Third result (*September 17, 1891*).—Twenty-nine new cases, fifteen being on the east half which received the extra treatment in the autumn of 1889. The old cases do not show any tendency to recover. One-third of the trees are still healthy.

REMARK.—The east thirty trees of the plat received a total of 8 pounds per tree of muriate of potash and the west thirty-six a total of 6 pounds per tree.

Fourth result (*July 21, 1892*).—Twenty-one new cases.

NINTH CONTROL.

Preliminary examination (*April 23, 1889*).—A plat directly north of XXVII is reserved for comparison. It contains sixty-five trees, originally sixty-six, in a rectangle 3 by 22. The trees are of similar appearance to those on XXVII. The tillage is the same, and, except on the extreme east end in the slight bottom, the soil and surface configuration are also the same. All the trees are healthy and of excellent appearance, except four which became diseased in 1887, and two which succumbed in 1888. The first four cases were in the bottom. The largest trees, other than these four, are on the west end.

First result (*August 22, 1889*).—Four new cases. As already noted the foliage on this control is not different from that on Plat XXVII or on the tenth control.

Second result (*September 17, 1890*).—The old cases have not recovered, and there are twenty-six new ones, *i. e.* twice as many as on XXVII.

Third result (*September 17, 1891*).—Twenty-three new cases. Only six healthy trees remain.

Fourth result (*July 21, 1892*).—Six new cases.

TENTH CONTROL.

Preliminary examination (*April 23, 1889*).—This plat lies between XXVII and XXVIII. It contains sixty-six healthy trees in a rectangle 3 by 22. The soil, tillage, surface configuration and the general appearance of the trees are the same as on the two areas under treatment. The largest trees are on the west end.

First result (August 22, 1889).—The plat continues free from yellows. The trees are not different in appearance from those on the plat treated with muriate of potash, or on that dosed with kainit.

Second result (September 17, 1890).—Twenty cases of yellows, including one very doubtful.

Third result (September 17, 1891).—Twenty-three new cases, and the old ones have not recovered. The tree which was doubtful in 1890 is now plainly affected. There are still twenty-three healthy trees, *i. e.* about the same number as on plat XXVII.

Fourth result (July 21, 1892).—Twenty new cases.

EXPERIMENT XXVIII.

Preliminary examination (April 23, 1889).—Loamy soil, recently plowed and in good condition; surface nearly level.

This plat contains sixty-six trees in a rectangle 3 by 22, lying south of Plat XXVII and separated from it by an untreated rectangle of the same area—the tenth control, already described. The trees are large but the branches do not touch. All are healthy except ten, which became diseased in 1888. The largest trees are on the west end.

First treatment (April 23, 1889).—Kainit (containing 12½ per cent K_2O) was sowed under each tree top, as far out as the branches extended and a little beyond, so that nearly the whole surface was covered. None, however, was put nearer to the trunks than 12 to 15 inches. Each tree received 8 pounds, equivalent to 864 pounds per acre. It fell upon mellow earth and was harrowed in a few days later.

First result (August 22, 1889).—Six new cases including one doubtful. None of the old cases have recovered or show any signs of improvement. The foliage and growth are not different from that of the trees on the controls to either side. I expected the foliage to be greener and the growth distinguishable.

Second treatment (April 19, 1890).—Kainit was sowed in a circle evenly under each tree top outward, so that altogether about four-fifths of the whole plat was covered. Each tree received 8 pounds, as in 1889. The kainit fell upon a dry surface. There were gentle rains on the 24th and 25th, and the whole orchard was cultivated soon after.

Second result (September 17, 1890).—Thirty-five new cases, *i. e.* nearly six times as many as last year, and nearly twice as many as on the controls to either side. None of the old cases have recovered or show any signs of recovery, and the doubtful tree of last year is now plainly diseased.

The trees on this plat have made a satisfactory growth, but are not clearly distinguishable from those on the the controls to either side.

REMARK.—The treatment was abandoned, but the trees were retained for another year.

Third result (September 17, 1891).—Nine new cases. Only six trees remain healthy. The old cases are very bad and the trees good only for fuel.

Fourth result (July 21, 1892).—Six new cases.

ELEVENTH CONTROL.

Preliminary examination (April 24, 1889).—This control is south of XXVIII, between the latter and Plat XXIX. It is a level area of loamy soil, similar to XXIX, and contains sixty-six trees in a rectangle 3 by 22. The tillage and general appearance of the trees are the same as on Plat XXIX. All of the trees are healthy except twelve, one-half of which became diseased in 1887, and the rest in 1888. The largest trees are on the west end.

First result (August 22, 1889).—Only one new case.

Second result (September 17, 1890).—Twenty-one new cases. None of the old cases have recovered.

Third result (*September 17, 1891*).—Twenty-three new cases. Only nine healthy trees remain.

Fourth result (*July 21, 1892*).—Eight new cases.

EXPERIMENT XXIX.

Preliminary examination (*April 24, 1889*).—This level plat is moister than the treated rectangles to the north. It consists of mellow soil, recently plowed and in good condition. There are sixty-six trees in a rectangle 3 by 22; three developed yellows in 1887, and ten in 1888. The trees have made a good growth and those not now diseased look well. As heretofore, the largest are on the west end.

First treatment (*April 24, 1889*).—Nitrate of potash was scattered evenly under each tree top as far out as the branches extended, but none was put nearer to the trunks than 12 to 15 inches. It was intended to put on 2 pounds per tree, but, in measuring out, the cup was heaped a little too much, so that sixty-two trees received a little more than 2 pounds each, and four trees on the east end received none whatever. The fertilizer was harrowed in some days later.

First result (*August 22, 1889*).—Nine new cases. One is on the untreated part, but two others are on the adjacent treated portion. This plat shows the effect of the fertilizer to a very marked degree. The foliage of all the trees is smooth and much greener than on the rows to either side, and the line of demarcation between treated and untreated is very distinct.

Second treatment (*August 26, 1889*).—The thirty-three trees on the east half of the plat each received 2 pounds of nitrate of potash. This was broadcasted evenly upon a smooth surface bearing low grasses and weeds, but was not harrowed in.

REMARK.—The sowing of 1889 was followed by the very heavy rains of April 26 and 27 before it was harrowed in, and yet the result showed conclusively that the fertilizer was not washed away, or carried to adjoining plats. On this score it therefore appeared reasonably safe to leave this second sowing upon the surface. This was also desirable on account of the nitrogen in the salt.

Third treatment (*April 19, 1890*).—One hundred and thirty-two pounds of nitrate of potash was equally divided and evenly distributed under each tree top, except that none was put on the three trees forming the west row, the other trees having received a little over 2 pounds each. In this way about four-fifths of the whole plat was covered. The salt was harrowed in.

Second result (*September 17, 1890*).—Twenty-eight new cases. None of the old cases have recovered. All of them seem to be worse than last year. The growth of the trees on this plat is better and the foliage is decidedly greener and more abundant than on the controls at either side. The plat can be distinguished as easily as last year, but the new cases are three times as numerous, and the extra autumn treatment of the east one-half appears rather to have invited the disease than otherwise.

REMARK.—The treatment was abandoned, but the trees were retained for further observation.

Third result (*September 17, 1891*).—Thirteen new cases. Only three healthy trees remain, all of them being on the part which did not receive the extra autumn treatment. There is now no difference in the appearance of the foliage on these trees and on those of the controls to either side. The trees are badly diseased.

Fourth result (*July 21, 1892*).—Three new cases.

Remarks on Plats XXVII–XXIX and their controls.

These treatments were made with three salts of potash. Only one of them received nitrogen and none of them received phosphoric acid. The results are given in the following table:

TABLE XV.—*Showing per cent of cases, by years, on three treated and three untreated plats in orchard of James W. Green, Magnolia, Del.*

Year.	Treated (198 trees).				Untreated (197 trees).			
	XXVII (66 trees), KCl	XXVIII (66 trees), K_2SO_4, $MgSO_4$, $MgCl_2$, 6Aq.	XXIX (66 trees), KNO_3.	Average.	Average.	9 (65 trees).	10 (66 trees).	11 (66 trees).
1887	0.0	0.0	4.5	**1.5**	**5.1**	6.2	0.0	9.1
1888	0.0	15.1	15.1	**10.1**	**4.1**	3.1	0.0	9.1
1889	1.5	9.1	13.6	**8.1**	**2.5**	6.1	0.0	1.5
1890	21.2	53.0	42.4	**38.8**	**34.0**	40.0	30.3	31.8
1891	44.0	13.6	19.7	**25.8**	**35.0**	35.4	34.8	34.8
1892	31.0	9.1	4.5	**15.2**	**17.2**	9.2	30.3	12.1
Total	98.6	100.0	100.0	**99.5**	**97.9**	100.0	95.4	98.4

EXPERIMENT XXX.

Preliminary examination (April 24, 1889).—This plat lies east of those just described. It consists of level loam, except the north end, which slopes gently toward the bottom. There the soil is poor, and of a different texture and color, *i. e.*, a reddish yellow (ferrous) sand, with occasional small, rounded pebbles of yellow quartz. It was plowed in April, and is in good condition.

There are sixty-eight trees in a rectangle 4 by 17. Five became diseased in 1887 and three in 1888. The rest are healthy. All not diseased are thrifty, but the trees on the north end, on the reddish-yellow sand, are noticeably small, contrasting also with the big trees in the neighboring bottom.

First treatment (April 24, 1889).—The following mixture was sown evenly under each tree top, as far out as the limbs extended, but not nearer to the trunks than 12 to 15 inches:

	Pounds.
Nitrate of soda	120
Dissolved boneblack	238
Total	358

In other words, the mixture was put on at the rate of 5¼ pounds per tree, or 560 pounds per acre. It was harrowed in a few days later.

First result (August 22, 1889).—Five new cases. The appearance of the old cases has not improved.

Second treatment (April 19, 1890).—The same quantity of the mixture used last year was distributed in the same way, *i. e.*, about three-quarters of the whole surface was covered, each tree receiving 5¼ pounds. It was harrowed in.

Second result (September 17, 1890).—Thirty-seven new cases, including one doubtful. None of the old cases have recovered. The trees on this plat have responded to the fertilizers very manifestly. They have made an excellent growth and are now full of foliage of good size and color. The contrast in color and general appearance with untreated neighboring trees is great and yet there are seven times as many cases as last year—a very discouraging result.

REMARK.—The treatment was abandoned, but the trees were retained for further study.

Third result (September 17, 1891.)—Seventeen new cases. One healthy tree.

Fourth result (July 21, 1892.)—One new case.

Remarks on XXX.

This plat may be compared with XXIV, XXV, and XXVI, the results of which are grouped in Table XIV. The per cent of cases, by years, is as follows: 1887, 7.4; 1888, 4.4; 1889, 7.4; 1890, 54.4; 1891, 25.0; 1892, 1.4; total, 100.

EXPERIMENT XXXI.

Preliminary examination (*May 4, 1889*).—This plat consists of a level area on the south side of the orchard next to the wheat field. It is south of Plat XXIX, and separated from it by the twelfth control. The soil is a mellow loam. It was plowed in April and is moist from recent rains.

There are sixty-six trees in a rectangle 3 by 22. Three of these became diseased in 1887 and nineteen in 1888. The rest of the trees are healthy, and even those now diseased had previously made a thrifty growth and are large.

First treatment (*May 4, 1889*).—Strong, unleached, hardwood ashes were evenly distributed and harrowed in over the whole surface at the rate of 9,697 pounds per acre, *i. e.* 89.79 pounds per tree.

First result (*August 22, 1889*).—Fourteen new cases. One of the trees marked diseased in 1888 (Bull. No. 9) is now entirely healthy, and the fact that none of the rest show any signs of recovery points to this as a wrong diagnosis. It is surprising that the healthy trees have not responded to the fertilizer more vigorously. They look well, but not much, if any, better than those on the control. About one-half of the diseased trees were cut back very severely at the time the ashes were put on, one-third to one-half of the branches being removed, *i. e.*, those most seriously affected, but this made no perceptible difference in the results.

Second treatment (*April 21 and 22, 1890*).—Ninety pounds of strong, unleached, hardwood ashes were evenly distributed under each tree top, so that about nine-tenths of the surface of the plat was covered. Had the whole surface been covered the rate per acre would have been been 10,800 pounds. The ashes fell upon plowed earth and were harrowed in.

Second result (*September 17, 1890*).—Eleven new cases. The old cases are worse than last year, and present a very sickly, miserable aspect. The trees, not too badly diseased, plainly show the effect of the ashes in the darker color of the foliage.

REMARK.—The treatment was abandoned and the diseased trees were cut down in the winter of 1890–91. The nineteen healthy trees were retained for further study, the ashes having become thoroughly disintegrated and blended with the soil by several plowings and harrowings.

Third result (*September 17, 1891*).—Sixteen new cases. Only three healthy trees remain. The effect of the ashes is still visible in increased growth and smooth, abundant foliage on the healthy trees and the healthy branches of the recently diseased ones. The leaves are not, however, as dark green as on plats which have received nitrogen this year, *e. g.*, in the younger orchard.

Fourth result (*July 21, 1892*).—Two new cases.

TWELFTH CONTROL.

Preliminary examination (*May 4, 1889*).—This plat is north of XXXI. The soil, surface, and tillage are the same. The trees also have the same general appearance of thrifty growth, except those which contracted the disease in 1887.

Sixty-five trees in a rectangle 3 by 22, the place of one tree being occupied by a large sassafras. Twenty-one are diseased, nine being cases of 1887 and twelve of 1888. The largest trees are on the west end.

First result (*August 22, 1889*).—Fourteen new cases, *i. e.*, just as many as on Plat XXXI, which received nearly 5 tons of ashes per acre. The old cases are much like those on XXXI; all are worse than last year, but not yet moribund.

Second result (*September 17, 1890*).—Twenty-two new cases. None of the old cases have recovered.

Third result (*September 17, 1891*).—Eight new cases, and no healthy trees.

Experiment XXXII.

Preliminary examination (May 3, 1889).—This plat is in the northwest part of the orchard next the highway and north of the twentieth control. It consists of level, mellow loam, recently plowed and free from weeds.

There are twenty-seven trees, originally twenty-eight, in a rectangle 2 by 14. All have made a good growth. One became diseased in 1888, and the rest are now healthy. The missing tree was not removed on account of yellows.

First treatment (May 3, 1889).—Strong, unleached, hard-wood ashes were evenly distributed over the whole surface, at the rate of 136 pounds per tree, equivalent to 14,700 pounds per acre. The ashes fell upon moist earth and were harrowed in a few days later.

First result (August 22, 1889).—No new cases. The one tree which was diseased remains so.

Second treatment (April 21-22, 1890).—Each tree again received 136 pounds of strong, unleached, hard-wood ashes, equivalent to over 7 tons per acre. The ashes were distributed evenly in circles around each tree, so that about nine-tenths of the whole surface of the plat was covered. The earth was then harrowed.

Second result (September 13, 1890).—Thirteen new cases, *i. e.*, about twice as many as on the control. The old case has not recovered.

Remark.—No further treatment. The effect of the ashes was not yet lost, and it was not deemed expedient to add more to this soil, the doses already amounting to a total of nearly 15 tons per acre.

Third result (September 16, 1891).—Seven new cases, and the old cases much worse than last year. Over 75 per cent of the trees have become diseased *since the second treatment.* The growth of these trees was not excessive.

Fourth result (July 21, 1892).—Five new cases. One healthy tree.

THIRTEENTH CONTROL.

Preliminary examination (May 3, 1889).—This plat consists of twenty-eight trees in a rectangle 2 by 14, next north of Plat XXXII. The trees are of the same age, size, and general appearance. The soil is also similar, the entire northeast corner of the orchard being very level and of uniform character. One tree became diseased in 1888. The rest are now healthy.

First result (August 22, 1889).—No new cases. The trees are as healthy and look as well as those on the treated strip.

Remark.—In none of the strips on this corner can the treated (ashed) portions be distinguished from the untreated.

Second result (September 13, 1890).—Seven new cases; the old cases not recovered.

Third result (September 16, 1891).—Twelve new cases. Eight trees are still healthy.

Fourth result (July 21, 1892).—Six new cases.

Experiment XXXIII.

Preliminary examination (May 3, 1889).—This plat is next north of the thirteenth control. The soil, tillage and other conditions are similar to Plat XXXII and the control. There are twenty-eight trees in a rectangle 2 by 14. All are healthy and have made a satisfactory growth.

First treatment (May 3, 1889).—Strong, unleached, hard-wood ashes were evenly distributed over the whole surface at the rate of 9,500 pounds per acre, *i. e.*, 88 pounds per tree. The ashes fell upon moist earth and were harrowed in a few days later.

First result (August 22, 1889).—No new cases. The trees are healthy but can not be distinguished by any difference in color or amount of foliage from the controls on either side—an unexpected result.

Second treatment (April 21-22, 1890).—Each tree received 88 pounds of strong, unleached, hard-wood ashes. These were evenly distributed and harrowed in under the branches of each tree, so that about nine-tenths of the whole plat was covered.

Second result (*September 13, 1890*).—Five cases of yellows on this plat, *i. e.*, five times as many as on the control.

Third result (*September 16, 1891*).—Twelve new cases, and none of the old cases show any tendency to recover.

Fourth result (*July 21, 1892*).—Eight new cases. Three healthy trees.

FOURTEENTH CONTROL.

Preliminary examination (*May 3, 1889*).—The conditions on this plat appear to be identical with those on XXXIII. It is north of the latter, and contains twenty-eight healthy trees in a rectangle 2 by 14.

First result (*August 22, 1889*).—No cases.

Second result (*September 13, 1890*).—One case.

Third result, (*September 16, 1891*).—One case. There have been fewer cases on this control than on any of the treated plats, but this may be wholly accidental.

Fourth result (*July 21, 1892*).—Eighteen new cases. Even the most resistent trees finally succumb, and the eight trees which remain healthy will probably become affected in 1893.

EXPERIMENT XXXIV.

Preliminary examination (*May 4, 1889*).—This plat is next north of the fourteenth control. The remarks under XXXIII, as to soil, etc., apply also to this area. There are twenty-eight trees in a rectangle 2 by 14. One became diseased in 1888, and the rest are now healthy. All are of nearly uniform size.

First treatment (*May 4, 1889*).—Unleached, hard-wood ashes were evenly distributed over the whole surface, at the rate of 69 pounds per tree, or 7,450 pounds per acre. The ashes fell upon moist earth and were harrowed in a few days later.

First result (*August 22, 1889*).—Two new cases. The old case shows no signs of recovery. The trees are not different in appearance from those on the control.

Second treatment (*April 22, 1890*).—The same treatment as last year, *i. e.*, 69 pounds of strong, unleached hard-wood ashes were evenly distributed under the branches of each tree. In this way about nine-tenths of the whole surface of the plat was covered.

Second result (*September 13, 1890*).—Two new cases, *i. e.*, twice as many as on one control, and about one-fifth as many as on the other. The old cases have not recovered.

REMARK.—No further treatment.

Third result (*September 16, 1891*).—Eight new cases, *i. e.*, twice as many as on one control, and eight times as many as on the other. The old cases are worse than last year.

Fourth result (*July 21, 1892*).—Thirteen new cases. Two healthy trees.

FIFTEENTH CONTROL.

Preliminary examination (*May 4, 1889*).—This plat is on the north side of XXXIV, and strictly comparable. There are twenty-eight trees in a rectangle 2 by 14. All are healthy except one, which became diseased in 1887.

First result (*August 22, 1889*).—No new cases.

Second result (*September 13, 1890*).—Eleven new cases. The old case has not recovered.

Third result (*September 16, 1891*).—Four new cases. The old ones are worse than last year.

Fourth result (*July 21, 1892*).—Nine new cases. Three healthy trees.

EXPERIMENT XXXV.

Preliminary examination (*May 4, 1889*).—This plat is north of the fifteenth control. Previous remarks as to soil, etc., apply here. Twenty-eight trees in a rectangle 2 by 14. Six became diseased in 1887 and two in 1888. The rest are now healthy.

First treatment (May 4, 1889).—Unleached hard-wood ashes were evenly distributed over the whole surface at the rate of 5,180 pounds per acre, *i. e.* 48 pounds per tree, but four trees on the east end received about 60 pounds per tree.

First result (August 22, 1889).—No new cases. The old cases show no tendency toward recovery. The trees are not different in appearance from those on the control strips.

Second treatment (April 21, 1890).—Each tree received 48 pounds of unleached hard-wood ashes. These were evenly distributed under the branches and outward so as to cover about nine-tenths of the whole plat.

Second result (September 13, 1890).—Six new cases. The old cases have not recovered.

REMARK.—Treatment abandoned.

Third result (September 16, 1891).—Four new cases. The old ones have not improved, but have become gradually worse and worse.

Fourth result (July 21, 1892).—Eight new cases. Two healthy trees.

SIXTEENTH CONTROL.

Preliminary examination (May 4, 1889).—This plat contains 28 trees in a rectangle 2 by 14 on the north side of Plat XXXV. The conditions are similar. Two trees became diseased in 1887 and the rest are now healthy.

First result (August 22, 1889).—One new case.

Second result (September 13, 1890).—Four new cases. The old cases have not recovered.

Third result (September 16, 1891).—Thirteen new cases.

Fourth result (July 21, 1892).—Six new cases. Two healthy trees.

EXPERIMENT XXXVI.

Preliminary examination (May 4, 1889).—This plat is north of the sixteenth control. The soil, surface configuration, tillage, age, size, and general appearance of the trees are similar to those of Plats XXXII to XXXV and their controls, already described. There are twenty-four trees in a rectangle 2 by 12. All are healthy and of uniform size.

First treatment (May 4, 1889).—Unleached hardwood ashes were evenly distributed over the whole surface at the rate of 4,860 pounds per acre, or about 45 pounds per tree. The ashes fell upon moist ground, and were harrowed in a few days later.

First result (August 22, 1889).—No cases. The trees are not distinguishable from the controls to either side.

Second treatment (April 21–22, 1890).—Each tree received 45 pounds of unleached hard-wood ashes. These were evenly distributed under the branches, covering about nine-tenths of the whole surface of the plat.

Second result (September 13, 1890).—There are now three cases of yellows on this plat.

REMARK.—The treatment was abandoned.

Third result (September 16, 1891).—Eleven new cases. The old ones are worse than last year.

Fourth result (July 21, 1892).—Eight new cases. Two healthy trees.

SEVENTEENTH CONTROL.

Preliminary examination (May 4, 1889).—This plat is in the extreme northwest corner of the orchard, directly north of XXXVI. It is a triangular strip containing twenty-four trees. All are healthy and very similar to those on XXXVI. The plat is also comparable in other particulars.

First result (August 22, 1889).—One case of yellows.

Second result (September 13, 1890).—Three and possibly four new cases. The one old case has not recovered.

REMARK.—September 13, 1890.—A careful inspection of Plats XXXI to XXXVI and controls 12 to 17 shows that the trees dosed with ashes have responded to the treatment. They showed no special difference last year, but this year the treated trees have made more growth, and the foliage is more abundant and darker green. It requires no map to locate the strips. In two instances, as may be seen from the map, the cases are much in excess on the treated strips, and these happen to be the ones which received the heaviest doses; in one the cases are much in excess on the untreated strip, and in three they are about the same on the treated and the untreated. Evidently the yellows has increased without reference to treatments.

Judging by the difference in the appearance of the trees in 1889 and in 1890, wood ashes have to lie in the soil some time before they become disseminated or decomposed and available for the use of the peach tree, and they should consequently be applied in the fall or winter if results are desired the following season.

Third result (September 17, 1891).—The tree which was doubtful last year is badly diseased and there are two new cases.

REMARK.—There are more weeds and taller ones on the treated strips XXXII–XXXVI, in the northwest corner of the orchard, than on the controls, and the trees themselves have also made a larger growth than those on the controls, but the foliage is not now bright green, as on the plats which have had nitrogen.

Fourth result (July 21, 1892).—Fifteen new cases; two healthy trees.

General remarks on XXXI–XXXVI and their controls.—These experiments were all undertaken with Canada hardwood ashes of excellent quality. Plat XXXI and the twelfth control were in the southeast part of the orchard; all the others in the northwest part. The general results are summed up in the following table:

TABLE XVI.—*Showing per cent of cases, by years, on six plats dosed with ashes and on six untreated plats in the orchard of James W. Green, Magnolia, Del., the treatments having begun in the spring of 1889.*

Year.	Treated (ashes, 201 trees).							Untreated (201 trees).						
	XXXI (66 trees).	XXXII (27 trees).	XXXIII (28 trees).	XXXIV (28 trees).	XXXV (28 trees).	XXXVI (24 trees).	Average.	Average.	12 (65 trees).	13 (28 trees).	14 (28 trees).	15 (28 trees).	16 (28 trees).	17 (24 trees).
1887..........	4.5	0.0	0.0	0.0	21.4	0.0	4.3	4.1	13.8	0.0	0.0	3.6	7.1	0.0
1888..........	28.8	3.7	0.0	3.6	7.1	0.0	7.2	3.7	18.5	3.6	0.0	0.0	0.0	0.0
1889..........	21.2	0.0	0.0	7.1	0.0	0.0	**4.7**	4.9	21.5	0.0	0.0	0.0	3.6	4.2
1890..........	16.7	48.1	17.9	7.1	21.4	12.5	**20.6**	**22.1**	33.8	25.0	3.6	39.3	14.3	16.6
1891..........	21.2	25.9	42.9	28.6	14.3	45.8	**30.6**	**21.3**	12.3	42.9	3.6	14.3	46.4	8.3
1892..........	3.0	1.9	28.6	46.4	28.6	33.3	**23.6**	**33.6**	......	21.4	64.3	32.1	21.4	62.5
Total...	98.4	79.6	89.4	92.8	92.8	91.6	**91.0**	89.7	100.0	92.9	71.5	89.3	92.8	91.6

EXPERIMENT XXXVII.

Preliminary examination (May 2, 1889).—This plat is in the middle north part of the orchard, some rods east of plats used for testing the Goessmann-Penhallow mixture. It is the highest part of the field and very level mellow loam, recently plowed and in good condition. East of this plat the field slopes gradually into an area which is two or three feet lower and drains into the east bottom already mentioned. There are seventy-five trees in a rectangle 5 by 15. All of them are healthy.

First treatment (May 2, 1889).—Unleached hardwood ashes were spread evenly over the whole surface at the rate of 5,940 pounds per acre, *i. e.*, 55 pounds per tree. They fell upon moist earth and were harrowed in a few days later.

First result (August 22, 1889).—No cases. Contrary to expectation, the trees are not different in amount of growth or greenness of foliage from those on Plat XXXVIII next west of this plat.

Second treatment (April 21, 1890).—Each tree again received 55 pounds of unleached hardwood ashes. They were evenly distributed under the branches, covering in this way about four-fifths of the whole surface of the plat. They were harrowed in.

Second result (September 17, 1890).—Nine well-marked cases of yellows. The trees on this plat are among the best in the orchard. They are very thrifty and bear abundant foliage of good size and color. At this date there are almost no yellow leaves. As compared with XXXVIII, the effect of the ashes is barely perceptible, but the trees are greener and thriftier than on the rows to the east or to the north.

Remark.—The treatment was abandoned, as much fertilizer having been put on as was thought advisable, *i. e.*, a total of nearly 6 tons per acre of strong ashes.

Third result (September 17, 1891).—Twenty-three new cases. The old ones are worse than last year. This plat is still comparatively free from yellows, much freer than those surrounding it.

Fourth result (July 21, 1892).—Thirty-three new cases. Ten healthy trees.

Experiment XXXVIII.

Preliminary examination (April 30, 1889).—This plat is just west of XXXVII in the highest part of the orchard. The surface is very nearly level, but has a gentle slope 1 to 2 feet, from the east to the west side. The soil is mellow loam, recently plowed, and in good condition. This plat is reserved for comparison with XXXVII, being to all appearances almost exactly like it.

There are seventy-five trees in a rectangle 5 by 15. All are of good size, having made a thrifty, uniform growth. One became diseased in 1887, and one in 1888. The others are now healthy.

First treatment—starvation (April 30, 1889).—Early Rose potatoes were planted on this plat. They were halved or quartered and dropped into twenty-five shallow north and south furrows, at a distance in the row of 12 to 15 inches, and then covered with a plow.

These potatoes, which were carefully cultivated without fertilizers, kept free from beetles, and harvested August 21, after the tops were dead, yielded 15 bushels. The season was wet, and the growth of the tops satisfactory, but the yield was very insignificant, and the tubers were small. This meager yield may be attributed to one or more of several causes, *e. g.*, (1) planting three weeks later than is customary; (2) too much shade; (3) insufficient plant food in the soil.

First result (August 22, 1889).—One new case. The old ones have not improved. Aside from these three trees the entire block is very healthy. The trees are in excellent condition and look fully as well as those to the east (ashed), or to the west (untreated).

Second treatment—starvation (April 19, 1890).—Early Rose potatoes were planted on this plat. Twenty-six north and south furrows were run out with a light plow, the tubers were then dropped into the moist furrow about one foot apart and covered by the plow.

These potatoes were tilled without fertilizers, and made a satisfactory growth until the June drought, when they dried up. They were harvested September 20, at which time almost none of the tops could be found. The yield was only 4¾ bushels of small potatoes, *i. e.*, about 6¼ bushels per acre.

Second result (September 17, 1890).—The trees look well. They have made a thrifty growth and are among the best trees in the orchard, but there are twenty-five new cases, two of them showing only very slight symptoms. None of the old cases have recovered.

Remark.—The treatment was abandoned.

Third result (September 17, 1891).—Thirty-two new cases. The old cases have not recovered. This plat is now considerably worse than the companion plat dosed with ashes.

Fourth result (July 21, 1892).—Ten new cases. Five healthy trees.

EIGHTEENTH CONTROL.

Preliminary examination (May 2, 1889).—A small triangular plat north of XXXVII and XXXVIII, and apparently less favorably situated. It contains twenty-three trees, three of which became diseased in 1887 and three in 1888.

First result (August 22, 1889).—Two new cases.

Second result (September 17, 1890).—Three new cases. The old ones have not recovered.

Third result (September 17, 1891).—Ten new cases.

Fourth result (July 21, 1892).—Two new cases. All diseased.

NINETEENTH CONTROL.

Preliminary examination (May 2, 1889).—A larger area east of XXXVII may also be used for comparison, although it is apparently much less favorably situated, owing to the slope of the land into the bottom to the east. This plat contains fifty-seven trees, three of which became diseased in 1887 and four in 1888.

First result (August 22, 1889).—Two new cases.

Second result (September 17, 1890).—Seventeen new cases. None of the old ones have recovered.

Third result (September 17, 1891).—Sixteen new cases, and none of the old ones have recovered.

Fourth result (July 21, 1892).—Nine new cases. Six healthy trees.

EXPERIMENT XXXIX.

Preliminary examination (May 2, 1889).—This plat is in the central south part of the orchard east of experiments XXIV and XXV, and the seventh and eighth controls. The surface is level. The soil is a mellow loam of very uniform appearance. It was plowed recently and is in good condition. There are forty-two trees in a rectangle 3 by 14. All are of nearly uniform size. One became diseased in 1887 and two in 1888. The rest are healthy and look well.

First treatment (May 2, 1889).—Unleached, hard-wood ashes were evenly distributed over the whole surface at the rate of 9,700 pounds per acre, *i. e.*, 89.93 pounds per tree. They fell upon moist earth and were harrowed in a few days later.

First result (August 22, 1889).—Six new cases, and the three old ones show no signs of recovery.

Second treatment (April 21, 1890).—Each tree received 90 pounds of unleached, hard-wood ashes. They were distributed evenly under the branches, covering in this way about four-fifths of the whole surface of the plat, making a total of 9,720 pounds per acre. They were harrowed in.

Second result (September 16, 1890).—Nineteen new cases, *i. e.*, three times as many as last year. The old cases have not recovered.

REMARK.—The treatment was abandoned. The total quantity of strong ashes already used amounted to nearly 10 tons per acre, and it was not deemed advisable to put on any more.

Third result (September 16, 1891).—Seven new cases, and the old ones are much worse than last year. Only seven trees have remained healthy.

Fourth result (July 21, 1892).—Five new cases.

EXPERIMENT XL.

Preliminary examination (April 21, 1889).—This plat consists of level mellow loam. It borders XXXIX on the east and is strictly comparable. The trees are of the same variety, age, size, and general appearance, and the soil is also apparently subject to the same physical and chemical conditions.

There are forty-two trees in a rectangle 3 by 14. All are healthy and of nearly uniform size.

First treatment, starvation (April 24, 1889).—This strip was planted to Early Rose potatoes. They were halved or quartered and dropped into sixteen shallow north-and-south furrows, at a distance in the row of about 15 inches, and then covered with the plow.

These potatoes were carefully cultivated without fertilizers, kept free from beetles, and harvested August 21, after the tops were dead, yielding 8½ bushels of small potatoes, a very meager return. The growth of the tops was good.

First result (August 22, 1889).—Five cases of yellows. The other trees look as well as on Plat XXXIX, although the latter received ashes at the rate of nearly 5 tons per acre.

Second treatment, starvation (April 19, 20, 1890).—This plat was again planted to Early Rose potatoes. They were cut into halves or thirds and dropped about 1 foot apart into sixteen shallow north and south furrows, which were then filled by the plow.

The potatoes were carefully cultivated and made a good growth until the June drouth, when they dried up. They were harvested September 20, the yield being most insignificant, *i. e,,* only 2¼ bushels of small potatoes.

Second result (September 17, 1890).—Twenty-three new cases, including one doubtful, *i. e.*, only four more than on the plat which has received 180 pounds of ashes per tree. The old cases have not recovered.

REMARK.—The treatment was abandoned.

Third result (September 16, 1891).—Nine new cases. Five trees remain healthy.

REMARK.—There are fewer weeds and grasses on XXXVIII and XL (starvation strips) than on their controls, dosed with ashes.

Fourth result (July 21, 1892).—Five new cases.

EXPERIMENT XLI.

Preliminary examination (May 2, 1889).—This plat and its companion are on the extreme east side of the orchard. It is a level area of rather poor, sandy soil, especially toward the north end. The plat was recently plowed and is free from weeds.

There are eighteen trees in a rectangle 2 by 9; one became diseased in 1888 and the rest are now healthy.

First treatment (May 2, 1889).—Unleached, hard-wood ashes were evenly distributed over the whole surface at the rate of 4,800 pounds per acre, *i. e.*, 44⅔ pounds per tree. They fell upon moist earth and were harrowed in a few days later.

First result (August 22, 1889).—Three new cases, and the old one has not improved.

Second treatment (April 22, 1890).—Each tree received 45 pounds of unleached, hard-wood ashes. They were evenly distributed under the branches and somewhat beyond, covering in this way about nine-tenths of the whole surface of the plat, at the rate of 4,860 pounds per acre. They were harrowed in.

Second result (September 18, 1890).—The old cases have not recovered, and there are ten new cases, including one doubtful, *i. e.*, more than on the starvation strip used for comparison. These trees have made a good growth and bear an abundance of fine, green leaves. They have responded to the ashes very satisfactorily, and so far as mere growth is concerned are much greener and thriftier than the trees on the control.

REMARK.—The treatment was abandoned, but, as in the other cases, there could be no doubt that a very considerable part of the ashes was still in the soil in an assimilable condition.

Third result (September 17, 1891).—Four new cases, and the old ones are much worse than last year. No healthy trees remain.

EXPERIMENT XLII.

Preliminary examination (April 30, 1889).—This plat joins XLI on the west. It is a level area of the same general appearance. There are eighteen trees in a rectangle 2 by 9. One became diseased in 1888. The rest are healthy and not to be distinguished from those on XLI.

First treatment, starvation (April 30, 1889).—This plat was planted to Early Rose potatoes. They were halved or quartered and dropped into ten shallow north and south furrows, at a distance in the furrow of 12 to 15 inches, and then covered with the plow. These potatoes were carefully cultivated without fertilizers, kept free from beetles, and harvested August 21, after the tops were dead. The growth of the tops was fair, but the yield amounted to only 2½ bushels of small potatoes.

First result (August 22, 1889).—Two new cases. The old case is not worse than the one on XLI. There is no marked difference in the appearance of the trees on these two plats.

Second treatment, starvation (April 21, 1890).—This plat was again planted to Early Rose potatoes, with exception of parts of two rows planted to Peach Blows to fill out. Eleven north and south furrows were run out with a plow, and the potatoes, cut into halves or thirds, were then dropped into these, about 1 foot apart, and covered with the plow.

The potatoes were cultivated without fertilizers, and made a satisfactory growth until the June drought, when they suffered severely. They were harvested September 20, when no tops were to be seen. The yield amounted to only 1½ bushels of small potatoes. The east row next to Plat XLI and somewhat beyond the dividing line felt the effect of the ashes, and the tubers were considerably larger than on any other row.

Second result (September 18, 1890).—The old cases have not recovered, and there are seven new cases. The trees do not look as well as on the comparison strip which was dosed with ashes.

REMARK.—The treatment was abandoned.

Third result (September 17, 1891).—Seven new cases. One tree is still healthy.

Fourth result (July 21, 1892).—One new case.

General remarks on Plats XXXVII to XLII.

These experiments were planned for the purpose of comparing the effects of good feeding with starvation. Three plats were dosed with large quantities of strong wood ashes, and a small amount of potash and phosphoric acid was removed from the other three by the cultivation of two crops of potatoes. The largest of the plats treated with ashes remained for three seasons somewhat freer from disease than its control, but no marked difference was observable on the other plats, and even on XXXVII the greater freedom from disease may have been due to entirely different causes since the final result was the same on all. The results are presented concisely in the following table:

TABLE XVII.—*Showing per cent of cases, by years, on three plats dosed with wood ashes, and on three starved plats in the orchard of James W. Green, Magnolia, Del.*

Year.	Treated.—Ashes. 135 trees.				Untreated (starved). 135 trees.			
	XXXVII (75 trees).	XXXIX (42 trees).	XLI (18 trees).	Average.	Average.	XXXVIII (75 trees).	XL (42 trees).	XLII (18 trees)
1887	0.0	2.4	0.0	**.8**	**.4**	1.3	0.0	0.0
1888	0.0	4.8	5.6	**3.5**	**2.3**	1.3	0.0	5.6
1889	0.0	14.3	16.7	**10.3**	**8.1**	1.3	11.9	11.1
1890	12	45.2	55.6	**37.6**	**42.3**	33.3	54.8	38.9
1891	30.7	16.7	22.2	**23.2**	**34.3**	42.7	21.4	38.9
1892	44	11.9	....	**18.6**	**10.3**	13.3	11.9	5.6
Total	86.7	95.3	100.0	**94.0**	**97.7**	93.2	100.0	100.0

EXPERIMENT XLIII.

Preliminary examination (*April 25, 1889*).—This very level plat is on the west side of the orchard about midway north and south. It is a rather moist, mellow loam, recently plowed and in good condition.

There are 84 trees in a rectangle 6 by 14, six of which became diseased in 1887, and two in 1888. The rest are now healthy. The largest trees are on the west side next the highway. One tree is a replant one or two years younger and smaller than the others.

First treatment (*April 25, 1889*).—Peruvian guano was drilled in at the rate of 1,296 pounds per acre, *i. e.*, 12 pounds per tree. This guano was reddish, with a strong smell and taste. It was guaranteed to contain 2 per cent K_2O, 7 per cent nitrogen, and 14 per cent P_2O_5. Being rather lumpy, it would not drill until sieved. Twelve pails full of lumps and small pieces of rock were removed and sown on the headlands and dead furrows. The remainder of the five bags was fine as flour, and drilled readily. An enormous rainfall ensued, beginning in the night and continuing twenty hours.

First result (*August 22, 1889*).—The old cases show no signs of recovery, and there are nine new cases.

The trees have made a most astonishing growth, and the color of the foliage of the whole block is now in very marked contrast to that of the trees surrounding it, or to that of any others in the orchard.. The maturity of the season's growth has been retarded and the energy of the trees has gone to the production of an excesssive amount of wood and foliage. The latter is now so abundant and so green that the block can be distinguished readily one-half mile away. There does not seem to be a yellow leaf on any tree, although the lower and older leaves on many trees in this orchard are now changing color and falling. Some of the trees bore a few peaches, and the effect of the guano was to retard maturity. The fruit was also inferior, and some of it withered green instead of ripening, a fact never before observed in this orchard, which has been noted for the fine quality of its fruit.

Clearly, this plat was dosed too heavily, except as a matter of experiment. Its exact boundaries can be told at a glance by the twice larger growth of grasses, weeds, and trees. For example, the white pigweed (*Chenopodium album*), not very noticeable in other parts of the orchard, has here grown luxuriantly, some being 12 feet high.

REMARK.—The foliage on this block continued green until very late in the autumn.

Second treatment (*April 18, 1890*).—Peruvian guano was drilled in at the rate of 1,296 pounds per acre, *i. e.*, the same amount as in 1889. This guano, reddish gray and fine as flour, having been sieved at the factory by request, possessed the characteristic odor and taste, and was guaranteed to contain 3.06 per cent K_2O, 6.72 per cent nitrogen, and 14.74 per cent P_2O_5. The same care was exercised as in 1889 to get the fertilizer on uniformly. The soil was mellow and free from grass and weeds, having been plowed but not harrowed.

Second result (*September 13, 1890*).—None of the old cases have recovered or show any tendency to recover, and there are forty-three new cases, including two doubtful. The general appearance of this block is much the same as last fall. The trees have made an unusual and excessive growth, and are now covered with an abundant, dark-green foliage, except where too badly diseased by yellows. These trees can be very easily distinguished from the controls and from all other treated plats by their excessive growth and dark-green leaves, but, nevertheless, many are now badly diseased. There are nearly five times as many cases as last year, and the outlook is not hopeful. The ratio of cases on this plat and on the twentieth control continues about the same as last year, *i. e.*, as two to one.

REMARK.—No guano of this composition could be procured in the spring of 1891 and this treatment was abandoned, together with two others projected for comparison in other orchards. Whether the guano was really instrumental in doubling the cases and hastening the decay of the trees on this plat is left for further inquiry.

Third result (*September 16, 1891*).—The two cases mentioned as doubtful in the autumn of 1890 are now plainly diseased, and there are nineteen new cases, but as a matter of fact three of these cases belong to the late autumn of 1890 or to the following winter, as was shown by an examination in the spring of 1891. Five healthy trees remain, all of them being on the east end where the trees had made least growth up to the time treatments began.

The trees as a whole present a most miserable aspect; many of them are very yellow, and sprout-infested, and the effect of the guano is not visible in the tree growths of this season. The old cases are much worse than last year. There is still much growth of grass and weeds, making the plat conspicuous though not such a forest and tangle as last year.

Fourth result '*July 21, 1892*).—Three new cases. The old cases are as bad as those which received no treatment, very yellow, stunted and sickly, with many dead branches.

TWENTIETH CONTROL.

Preliminary examination (*April 25, 1889*).—This plat joins XLIII on the north, and appears to be identical with it in composition of soil and in physical conditions. It contains eighty-four trees in a rectangle 6 by 14. Two became diseased in 1887, and four in 1888. Those not diseased by yellows are healthy, thrifty, and of nearly uniform growth. They are of the same variety, age, size, and general appearance as those on the plat dosed with guano.

First result (*August 22, 1889*).—Four new cases, *i. e.*, less than one-half as many as on the treated block. None of the old cases have recovered.

Second result (*September 13, 1890*).—None of the old cases have recovered, and there are twenty-three new ones, including one doubtful, *i. e.*, about one-half as many cases as on XLIII. The trees have made less growth, and the foliage is not nearly so abundant or so green, which, however, is no disadvantage in mid-September.

Third result (*September 16, 1891*).—Twenty-four new cases. None of the old cases have recovered. The plat still bears twenty-seven healthy trees.

Fourth result (*July 21, 1892*).—Twenty-four new cases. Three healthy trees.

EXPERIMENT XLIV.

Preliminary examination (*August 23, 1889*).—This experiment consists of ten trees on level ground in the northeast corner of the orchard. All were healthy in the autumn of 1888, and all became diseased by yellows during the season of 1889. All had made a good growth, and most of them are not yet bad-looking trees, although some are worse than others. For this experiment I selected the healthiest-looking certainly diseased trees which could be found in that part of the orchard. They are Troths. All, apparently, bore premature fruit, and all now bear some diseased shoots on a few limbs. Other limbs appear to be entirely healthy.

First treatment, (*August 23–24, 1889*).—One and one-half bushels of tobacco dust (heaped measure) was evenly distributed around each tree, as far out as the branches spread, and was dug into the surface soil very completely. The grade of dust used was very strong and free from extraneous matters. When nine trees had been treated a heavy shower put an end to the day's labor. This rain must have drenched all the roots with strong tobacco juice, as the dust had already been dug into the earth under eight trees. The rest of the work was completed the next day. The weight of the dust varied according to fineness from 36 pounds to 45 pounds per tree, but one tree received 25 pounds only, and one 53 pounds.

Second treatment (*May 19, 1890*).—One and three-fourths bushels (45 pounds) of strong tobacco dust was distributed under each treetop and immediately dug into the mellow earth. The quality of the dust was equal to that of last year. It was put on very copiously, especially near the trunks, in a circle having a radius of not more than 5 feet. A very heavy rainfall occurred next morning.

First result (*September 18, 1890*).—These ten trees have made a good growth for diseased trees, and are full of vigorous, green foliage. They have responded to the stimulus and are decidedly greener and thriftier looking than their neighbors, bearing at this date comparatively few red or yellow leaves, while the neighboring trees bear many. Yet not one shows any sign of recovery, the development of the disease having kept pace with the increased growth of the trees. In fact, notwithstanding the treatment, each tree is worse than last year, being now affected on all the larger limbs. Each tree bears dozens of water-shoots which are much branched and feeble at the extremities, and, on each one, hundreds of winter buds have unfolded during the last two months, or are now beginning to grow.

REMARK.—The treatment was abandoned.

Second result (*September 17, 1891*).—One tree contains much foliage and many good looking normal leaves. The rest are miserable objects. This best looking tree is still diseased and sprout infested in all parts.

Third result (*July 21, 1892*).—These trees are now very badly diseased and indistinguishable from others in that part of the orchard.

GENERAL REMARKS.

1889: At the time of the treatments the orchard was just out of blossom and the leaves were beginning to push. On April 26 pears and cherries were in full bloom, and most peach orchards were nearly through blossoming.

The whole orchard was plowed shallow in the spring before treatments began and cultivated several times afterwards, but the season was so wet that it proved almost impossible to keep down grass and weeds. The first harrowing was done immediately after corn-planting, *i. e.*, a few days after the treatments were completed.

The season of 1889 was exceptionally rainy from April to August. In fact, it was wetter than the very rainy seasons of 1886 and 1887, but the yellows was less prevalent than in 1888, which was comparatively dry.

There was only a small crop of fruit (1,100 baskets), but what matured was of excellent quality. None of the varieties produced a full crop. The Crawford Late and varieties east of that bore, perhaps, one-third crop. On varieties west of Crawford Late, *i. e.*, the west fifteen rows, there were very few peaches.

At my request all of the diseased trees have been allowed to stand. Only three or four are dead—a much smaller number than was expected. Many of the cases, however, are very yellow and sickly, especially those attacked in 1887. By letting them remain, I have in no way hindered the effect of the fertilizers on the healthy trees, if the disease is due to starvation, whereas, if the malady is a communicable one, conditions have been established which will be likely to favor its spread.

1890: *April 19.*—This orchard was carefully plowed about April 1, but was not harrowed at that time. It is now free from grass and weeds and in very good condition. There was considerable rain in early spring, but has been none for about a week. The soil begins to be dry, but only for a short distance down, the great mass of the turned furrow being damp. None of the fertilizers blew away, and in some places they fell upon a damp surface. Vegetation is further advanced than last year at this date, owing to the unusually mild winter and early spring. The peach blossoms are gone, having been destroyed by winter and spring frosts, and the shoot-axes have pushed one-fourth of an inch or more, the first leaves of the shoots being 1 to 2 inches long, but not yet numerous enough or large enough to obscure the branches or give at a distance anything more than a very light-green tint to the tops of the trees. Cherry trees are still in full bloom, but pear trees are out of blossom. There will be no peaches this season, and the possible effect of their absence in checking the progress of the disease will be looked for with great interest.

July 18.—The orchard was harrowed a few days after the treatments were completed, and was cultivated at intervals from that time until the end of June. Then it was allowed to become grassy and weedy. Dry weather began early in June, and still continues. It is extremely dry. Rain is much needed.

September 12.—Rain began near the end of July, and from that time the weather was seasonable and very satisfactory for tomatoes and other late crops, which yielded abundantly. As anticipated, there was no fruit. In the entire orchard I found only one ripe peach, and Mr. Green got half a dozen—not more. There were no peaches in this part of Delaware, such an entire failure never having been known before.

Mr. Green continues to let the diseased trees remain. None have been removed except about 125 in the southwest corner to make room for an experimental block of peaches budded upon plum roots.*

There has been a very great increase of the disease this year in this part of Delaware in spite of the absence of fruit.

1891: *Spring.*—The orchard was plowed early in April and harrowed in May. Mr. Green is very much discouraged at the rapid spread of the disease, and would have cut down most of the orchard last winter but for my appeals. None of the trees show any indications of recovery, and he is losing the use of the land. He desires to plant it to corn, but I have persuaded him not to do so.

May 7.—The foliage is growing rapidly. The young fruits, for the most part, have finished shedding the cap, and the largest are the size of small filberts. The eleven rows of Troths on the east end of the orchard have set very full; the other varieties bear only a few. This variety was noticeaby red with blossoms on April 13.

September 17.—The cultivation this year was somewhat less thorough than usual. The orchard has not been harrowed since early summer and is now full of low grass and tall weeds. The whole orchard looks much worse than last year, and the owner only waits for the completion of the experiments to cut it down. There are many more new cases than any previous year except 1890, and the old cases are worse than ever, irrespective of treatment. With exception of one tree, already mentioned under Experiment XLIV, there are none which now give any evidence of being better for the treatments.

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*See Bull. 1, 1891, Div. Veg. Pathology, p. 40.

The orchard yielded 2,100 baskets of good fruit in spite of the frosts of late spring, and probably 1,000 baskets prematured and rotted. The six rows of Beers Smock, on the west side next the highway, were especially bad. Peach gathering is about over. The crop above the frost line was enormous. Apples and pears have also produced more abundantly than for years. The oldest inhabitant can not remember such an apple crop, and the same is true of pears, every tree of large orchards being full to breaking. Farmers are now picking tomatoes, and the crop is large and fine. Vegetables of all kinds are abundant and good. Corn is also an excellent crop, the stalks being tall and well eared. It has been a year of plenty.

There was no drouth as last year, and rains occurred at frequent intervals throughout the season. During peach harvest there was too much rain. Only a few trees have died, even among the cases of 1887, and if allowed to remain most of them would probably consume over five years in dying. In its chronic nature peach yellows is very different from the Rosette of Georgia and Kansas.

1892: *July 22.*—No fruit this year. Most of the old cases were removed last spring. Nearly every tree which was healthy last fall is now diseased. The orchard was plowed in the spring and harrowed as usual. It is now nearly free from weeds, and the larger open spaces have been planted to maize, which is small and backward owing to the extremely late, wet spring. The weather has been dry for the last five or six weeks. The remainder of the orchard will be dug out this winter.

SUMMARY.

The cases and per cent of cases, by years, are shown in the following table:

TABLE XVIII.—*Showing the progress of peach yellows in the orchard of James W. Green, Magnolia, Del. (2,922 trees).*

Year.	Cases.	Per cents.	Year.	Cases.	Per cents.
1882	0	0	1889	254	8.7
1883	0	0	1890	858	29.4
1884	0	0	1891	671	23.0
1885	0	0	1892	456	15.5
1886	3	0.1			
1887	255	8.7	Total	2,797	95.7
1888	311	10.6			

From this it will be observed that 95 per cent of the trees have become affected within a period of six years and 67 per cent within the last three years. The most notable feature is a decrease of the disease in 1889, followed by a great increase in 1890 and 1891. The falling off of cases in 1892 is attributable to a lack of healthy material rather than to any decrease in the virulence of the disease. This is shown very clearly by Series XV and by many other orchards south of Dover. This orchard is ruined, although it has been planted only ten and a half years. The value of such an orchard ten years ago in that locality would have been not less than $10,000.

The following table gives the number of healthy trees at the beginning of the experiments, and the cases, by years, since the spring of 1889, on the treated and untreated plats, as indicated on Plate XXV. The totals and per cents are also added:

TABLE XIX.—*Showing by cases and per cents the general results of preventive treatments begun in the spring of 1889 in the orchard of James W. Green, Magnolia, Del.*

[Consult Plate XXV for location of plats.]

Plat.	Treatments. 999 healthy trees.					
	No. of healthy trees.	Cases each autumn.				Total cases.
		1889.	1890.	1891.	1892.	
XX	56	2	2	12	32	48
XXI	56	10	12	7	24	53
XXII	57	5	3	26	17	51
XXIII	50	3	19	23	5	50
XXIV	76	1	44	24	6	75
XXV	60	16	38	6	......	60
XXVI	33	3	30	......	......	33
XXVII	66	1	14	29	21	65
XXVIII	56	6	35	9	6	56
XXIX	53	9	28	13	3	53
XXX	60	5	37	17	1	60
XXXI	44	14	11	16	2	43
XXXII	26	0	13	7	5	25
XXXIII	28	0	5	12	8	25
XXXIV	27	2	2	8	13	25
XXXV	20	0	6	4	8	18
XXXVI	24	0	3	11	8	22
XXXVII	75	0	9	23	23	55
XXXIX	39	6	19	7	5	37
XLI	17	3	10	4	......	17
XLIII	76	9	43	19	3	74
Total	999	95	383	277	200	955
Per cent	....	9.5	38.3	27.7	20.0	95.6

Plat.	Controls. 1,046 healthy (adjacent) trees					
	No. of healthy trees.	Cases each autumn.				Total cases.
		1889.	1890.	1891.	1892.	
3	96	0	15	41	31	87
4	56	4	8	26	13	51
5	70	8	10	18	20	56
6	99	4	23	30	42	99
7	65	10	29	23	2	64
8	28	9	17	2	......	28
9	59	4	26	23	6	59
10	66	0	20	23	20	63
11	54	1	21	23	8	53
12	44	14	22	8	......	44
13	27	0	7	12	6	25
14	28	0	1	1	18	20
15	27	0	11	4	9	24
16	26	1	4	13	6	24
17	24	1	4	2	15	22
18	17	2	3	10	2	17
19	50	2	17	16	9	44
XXXVIII	73	1	25	32	10	68
XL	42	5	23	9	5	42
XLII	17	2	7	7	1	17
20	78	4	23	24	24	75
Total	1,046	72	316	347	247	982
Per cent	....	6.9	30.2	33.2	23.6	93.9

In making the preceding comparison no account was taken of the southwest and northeast corners, or of some trees on the east end and in the middle south part of the orchard. The latter were not needed in making the comparison, and the former (northeast and southwest corners) were excluded, not only because the soil and physical conditions are somewhat unlike the rest of the orchard as already stated, but because these two areas showed a disproportionately large number of cases from the start, and were presumably more subject to the disease than other parts. These rejected areas are taken into account, however, in the following table, which gives the per cent of cases, by years, since 1889 in the whole orchard and in various parts of it:

TABLE XX.—*Showing changes which have taken place in healthy trees in the orchard of James W. Green, Magnolia, Del., since the spring of 1889.*

Areas.	No. of healthy trees.	Per cent of cases of yellows.				Total.
		1889.	1890.	1891.	1892.	
Entire orchard	2, 350	10. 8	34. 8	30. 0	19. 4	95. 0
Treated plats	999	9. 5	38. 3	27. 7	20. 0	95. 6
Controls	1, 046	6. 9	30. 2	33. 2	23. 6	93. 9
Rejected portions	306	28. 4	51. 3	15. 0	2. 9	97. 6
Orchard exclusive of treatments	1, 351	11. 8	34. 9	29. 0	18. 9	94. 6

From an examination of these tables and a study of Plate XXV, the conclusion is irresistible that the fertilizers exerted no restraining influence.

SERIES IV.—ORCHARD OF DR. W. S. MAXWELL, STILL POND, KENT COUNTY, MD. (Plate XXVI.)

This orchard is about 3 miles from the village of Still Pond, at the mouth of Lloyd's Creek, on the level summit of a hill overlooking Chesapeake Bay and the mouth of Sassafras River. The trees came from the nursery of R. G. Nicholson, Chestertown, Md., and were, presumably, grown from Kent County pits and buds. They were set in November, 1884, and the distance apart approximated 17 by 19 feet, giving 134 trees per acre. The orchard consists of five varieties of two rows each, set in the following order, counting from the north side: Troths, Richmond, Old Mixon (free), Marys Choice and Salway. As it now stands the orchard is ten rows wide (north and south) and twenty-four rows deep, extending from the farm lane nearly to the woods.

The trees received good cultivation and made a satisfactory early growth. They were not troubled either by root aphides or by borers. Corn was grown between the trees the first two years, but no fertilizers were used on them until 1889. The growth of the trees up to the time the treatments began had been very good. The main limbs and the trunks were still smooth and the trees were of very nearly uniform size. The only exceptions were a few trees on the northeast end, mentioned below.

The trees bore no fruit in 1885, 1886, or 1887. In 1888 the yield amounted to 161 baskets, distributed as follows: Troths, 99; Richmond, 10; Old Mixon, 52; Marys Choice, 0; Salway, 0.*

Yellows first appeared in the orchard in 1887. That summer there were six cases on the extreme east end, and three further west toward the middle, north side. The following year there was a large increase of cases. Nine of these were on the extreme east end of the orchard, next to the woods, and the location of the remainder is shown on Plate XXVI. The total cases of these two years amounted to about 17 per cent of the entire orchard. These trees were dug out.

The reasons which led to the selection of this orchard are in the main the same as those already given for Mr. Green's, *i. e.*, (1) The uniform character of most of the soil and the very uniform and handsome appearance of most of the trees. (2) Their location in the center of a great peach district. (3) The presence of yellows to a serious extent in many of the bearing orchards of this part of Kent County, and its existence in this orchard, with the prospect of additional cases. (4) The entire control of the trees for an indefinite period with the cordial coöperation of the owner.

For treatment the orchard was divided into six sections, numbered from the farm road eastward toward the woods, and crossing the varieties. Originally each section contained 40 trees, but, in 1888, 29 of the 240 were removed on account of yellows. This does not include a triangular plat on the extreme east end next to the woods. On this small strip all but one of the trees have contracted yellows, and only 7 remain, the rest having been dug out in 1888.

The trees have been pruned from time to time in the ordinary manner, *i. e.*, by the removal of undesirable branches, but no systematic effort has been made to keep them shortened in. They are of good size, with rounded, well-developed tops, and smooth branches and bodies. They have not been injured by borers or in any other way, and are noticeably free from bruises, rough bark, dead limbs, or decayed spots. With exception of six trees on the east end, all are healthy and handsome.

This field slopes toward the forest, but so imperceptibly that for all practical purposes it may be considered level. On the northeast corner there is, however, a more decided slope into a ravine, but this involves only a few trees.

The field is an upland about 100 feet above the river. The distance to Lloyd's Creek on the east is only a few rods, down a steep, well-wooded hill. There is no artificial drainage, and the depth of the nearest well on the same level, one-half mile distant, is 65 feet, the depth of water in it varying from 6 to 9 feet. The soil of this orchard is a level, rather compact clay loam, 6 to 8 inches deep, and quite distinct from the sub-soil. The color of the soil when dry approaches broccoli brown and when wet is slightly darker than sepia brown.

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*This variety actually produced about fifty baskets, but they rotted before they were fit to pick.

It is a fine, mellow earth, easy to work, free from stones and gravel, and inclined to crack open as it dries. The subsoil is a porous yellow clay. Towards the forest the soil becomes somewhat mellower and darker (hair brown, when dry) and the corn which grew on it in 1887 was observed to have a ranker growth than in other parts of the orchard. Judging from the growth of the trees and from other indications it is a fertile soil, well adapted to corn, wheat, and many farm crops, and comparable with the best clay loams on the peninsula. The weeds are such as grow on good lands. A specimen of poke, *Phytolacca decandra*, found on similar soil in a neighboring orchard only a few rods distant, had reached a height of 8 feet with an equal spread of branches and a stem diameter of 2 inches. This magnificent specimen, full of green leaves and purple berries, stood in a badly diseased orchard, and between two affected trees. The size and composition of the neighboring forests also indicate a good soil. The forest cover in the immediate vicinity consists of oaks (chestnut, white, post, red, and scarlet), locust, chestnut, black cherry, walnut, hickory, tulip tree, mulberry, elm, hackberry, beech, sour gum, red bud, holly, sassafras, persimmon, red cedar, flowering dogwood, etc. There is also a dense undergrowth of shrubs, vines, and herbs, which delight in a strong soil.

The orchard is bounded on the north by an open field, now occupied in part by an experimental orchard of peach on plum. This field was formerly in peach orchard, which suffered severely from yellows in 1886, 1887, and 1888. Only a few trees remained at the beginning of this experiment, and these were badly diseased. The orchard is bounded on the east by a fringe of forest, bordering a steep hillside, ending in the creek. On the south is a continuation of peach orchard (Series V), and on the west is a level, open field, used for pasture and corn land. In addition to the diseased orchard already mentioned, one was removed from the brow of the hill a few years since, and there is a badly diseased one in the bottom further to the north (Series VIII).* Two others, still further north, bordering the water, became badly affected before they had been set six years, and were removed in the autumn of 1888. Within a radius of a mile or two there are, or have been until recently, diseased orchards in nearly all directions. Among others, an old one was removed in 1888 from the west side of this same farm, three-quarters of a mile distant.

Parts of this farm have been under cultivation more than one hundred years, but I have not been able to learn the exact early history of this field. It was a stock and grain farm until 1860, and is now one of the most successful pear farms on the peninsula. Apples and cherries also thrive, and until recently peaches have been a profitable crop, but this field was never before in peaches or other fruits.

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* No. 18 of Bull. 9.

Peaches and pears are grown very extensively in this county, especially along the water courses. Wheat and Indian corn are also staple crops. Small fruits, asparagus, Irish potatoes, sweet potatoes, and many other crops are cultivated to a lesser extent. Tobacco was also grown in early times (see p. 26), but its cultivation has been abandoned. Commercial fertilizers are commonly used, and stock raising is of minor importance. Until recently peaches have been by far the most profitable crop, and the county contains thousands of acres of bearing orchards.

EXPERIMENT XLV.

Preliminary examination (May 9, 1889).—This plat is on the west side of the orchard, bordering the farm road. Originally it contained forty trees in a rectangle 4 by 10, but two have been removed on account of yellows, which appeared in 1888. The trees have made a satisfactory growth and all are healthy.

The soil has been plowed and is now packed down by rains and free from weeds. This remark applies to all the plats.

First treatment (May 9, 1889).—Each tree was dosed with the following substances:

	Pounds.
Dissolved bone ash (15 per cent soluble and available P_2O_5)	3.4
Kainit (12½ per cent K_2O)	5.0

These substances were weighed, and scattered evenly under the tree tops so that about two-thirds of the whole surface of the plat was covered, *i. e.*, the parts most drawn upon by the roots. They were plowed down the same day to a depth of about 3 inches. The amount per tree is equivalent to 459 pounds of bone ash and 675 pounds of kainit per acre, or to as much as 688 pounds of the one and 1,012 of the other, if the whole surface had been covered at this rate.

First result (September 5, 1889).—One new case. One tree is now missing, but the reason for its removal is not known.

Second treatment (May 13, 1890).—Each tree (thirty-seven) received 11 pounds of the following mixture:

	Pounds.
Dissolved bone ash (15 per cent soluble and available P_2O_5)	6
Kainit (12½ per cent K_2O)	5

This was weighed out and sowed carefully under each tree top, and a little beyond, so that nearly the entire surface was covered. It fell upon a level surface bearing a scattered growth of grass, weeds, and clover, and was at once plowed down about 3 inches.

Second result (October 8, 1890).—The diseased tree has not recovered, and there are seven new cases, including one which is doubtful. The trees on this plat are now at least one-third larger than those on the control.

Third treatment (April 21, 1891).—Each tree received the same treatment as last year, *i. e.*, 11 pounds of a mixture consisting of 5 pounds of kainit and 6 pounds of dissolved bone ash. This was carefully weighed out for each tree, and sowed in circles under the branches so that about seven-eighths of the whole surface was covered. It was plowed down at once about 3 inches.

Third result (October 6, 1891).—The old cases are much worse than last year, and there are eleven new cases. Eighteen trees, *i. e.*, less than one-half, are still healthy.

Fourth result (October 10, 1892).—Thirteen new cases.

TWENTY-FIRST CONTROL.

Preliminary examination (May 9, 1889).—This plat consists of forty trees in a rectangle 4 by 10, next east of the last-mentioned plat. The soil and other conditions are identical. All the trees are healthy and of uniform appearance.

First result (September 5, 1889).—No cases.

Second result (October 8, 1890).—There are now five cases. The shoots of the season are well ripened, and about two-thirds of the leaves have fallen, but some varieties bear more foliage than others. There is now about the same amount of foliage on this plat as on XLV and XLVI to either side, and the color is not remarkably different, but the trees on the treated plats have made a larger growth.

Third result (October 6, 1891).—Eleven new cases, including one doubtful. The old cases have not recovered, but are worse than last year.

Fourth result (October 10, 1892).—The tree which was doubtful is now a plain case, and there are twenty new cases.

EXPERIMENT XLVI.

Preliminary examination (May 9, 1889).—This plat is next east of the twenty-first control. Originally it contained forty trees in a rectangle 4 by 10, but four were removed in 1888 on account of yellows which developed that year. The remaining thirty-six trees are healthy and of uniform appearance. The soil is the same as on XLV and the twenty-first control.

First treatment (May 9 and 10, 1889).—Each tree was dosed as follows: Dissolved bone ash, 3.4 pounds; kainit, 10 pounds. These substances were scattered evenly under the branches, so that about two-thirds of the whole surface of the plat was covered. They were plowed down on the 10th to a depth of about 3 inches. The amount given each tree is equivalent to 459 pounds of bone ash and 1,335 pounds of kainit per acre, and to one-third more than this if broadcasted over the whole surface—*i. e.*, the parts most drawn upon by the roots, and actually covered, received at the rate of 688 pounds of bone ash and 2,000 pounds of kainit per acre.

First result (September 5, 1889).—There are no well-defined new cases, but four trees on the south end of the east row are unhealthy and suspicious. This plat may also be compared with the twenty-first control. There is not now much difference in the appearance of the foliage, except that on this plat and XLV it is yellower, apparently from too heavy a dose of kainit.

Second treatment (May 13, 1890).—Each tree received 16 pounds of the following mixture:

	Pounds.
Dissolved bone ash (15 per cent soluble and available P_2O_5)	6
Kainit ($12\frac{1}{2}$ per cent K_2O)	10

This was evenly distributed under each tree top, and was at once plowed down 3 inches. Nearly the whole surface was covered, the sowings being made in circles outward from the trunks to beyond the spread of the branches.

Second result (October 8, 1890).—The four trees which were suspicious are now plainly diseased by yellows. One other tree is now also much as they were last year. One tree was broken down by the wind and has been removed. The remainder continue healthy. They are now larger than those on the twenty-first control. The shoots of the season are well matured, and over two-thirds of the foliage has fallen, the remainder being reddish and yellowish green. A small branch on one of the diseased trees is now in blossom.

Third treatment (April 21, 1891).—Each tree received 16 pounds of the same mixture as last year. This was sowed around each tree, the whole surface being covered, except where trees were missing. It was plowed down at once about 3 inches.

Third result (October 6, 1891).—The old cases have not recovered, the doubtful tree is diseased, and there are five new cases.

Fourth result (October 10, 1892).—Thirteen new cases.

EXPERIMENT XLVII.

Preliminary examination (*May 9, 1889*).—This plat is next east of XLVI. Originally it contained forty trees in a rectangle 4 by 10, but four of them were removed in 1888 on account of yellows. The remaining thirty-six are healthy and of uniform appearance. The soil is also similar to that on the plats already described.

First treatment (*May 9 and 10, 1889*).—Each tree was dosed as follows: Dissolved bone ash, 3.4 pounds; muriate of potash, 2 pounds. These substances were scattered evenly under the branches of the trees so that about two-thirds of the earth's surface was covered. They were plowed down May 10 to a depth of about 3 inches. The amount given each tree is equivalent to 455 pounds of bone ash and 268 pounds of muriate of potash per acre, or to one-third more than this if the whole surface had been covered. Rain in the afternoon wet down the earth thoroughly.

First result (*September 5, 1889*).—Three unhealthy, suspicious trees, like those on XLVII, and one well-defined case of yellows.

Second treatment (*May 13, 1890*).—Each tree received 11 pounds of the following mixture:

	Pounds.
Dissolved bone ash (15 per cent soluble and available P_2O_5)	7
Muriate of potash (50 per cent K_2O)	4

The mixture was sowed evenly under each tree top, and somewhat beyond, covering in this way nearly the whole surface of the plat. It was at once plowed down about 3 inches. The amount given each tree is equivalent to 938 pounds of bone ash and 536 pounds of muriate of potash per acre.

Second result (*October 8, 1890*).—The old case has not recovered; the three suspicious trees are now plainly diseased; and there are twelve new cases. A poor showing for bone and potash! The trees have made a larger growth than on the twenty-second control, and bear more foliage.

Third treatment (*April 21, 1891*).—Each tree received 11 pounds of the same mixture as last year, *i. e.* dissolved bone ash 7 pounds, and muriate of potash 4 pounds. This was weighed out and carefully distributed around each tree, the whole surface, except vacant places, being covered. It was plowed down the same day to a depth of about 3 inches.

REMARK.—The one case of 1889 showed signs of improvement in the autumn of 1890 and was set apart for special treatment. In the spring of 1891 it received the following treatments: (1) Four pounds of the same mixture as the other trees on the plat; (2) 13 pounds of a mixture of bone ash and kainit, the same as used on Plat XLV; (3) 18 pounds of a mixture of bone ash and nitrate of potash, the same as used on Plat LII. These substances were sowed evenly under the tree top as far out as the branches extended, *i. e.*, in a circle having a diameter of 14 feet. They were at once plowed down about 3 inches. The tree still gave indications of disease.

Third result (*October 6, 1891*).—None of the old cases have recovered, and there are fourteen new cases, three of which should, however, be credited to the six months following October 8, 1890, having shown the disease as early as April 15, 1891. Only six trees are still healthy.

REMARK.—The case of 1889 singled out for special treatment responded with considerable vigor and looks as well as it did last year although it is still plainly diseased. It bears many normal shoots and good leaves which are still green, but it bore a few peaches all of which were red-spotted and premature, and it now bears at least 100 pale feeble shoots which have developed since midsummer and are still unfolding. These are not confined to one part of the tree, but occur on all the important branches. The tree is not cured but its vegetative vigor is certainly improved, and quite remarkably so, considering that it has now been diseased three seasons. The weeds in the fore-ground of the photograph made in 1891 also show to a marked degree the effect of the heavy fertilization.

Fourth result (October 10, 1892).—Three new cases. The tree under special treatment was examined in July and October and found to be much worse than last year; many dead limbs and foliage yellowish.

TWENTY-SECOND CONTROL.

Preliminary examination (May 9, 1889).—This plat is next east of XLVII and resembles that, except that the extreme north end slopes towards a ravine and is poorer soil, as indicated by the change in color and by lesser growth of the trees. Originally there were forty trees in a rectangle, 4 by 10, but eight contracted yellows and were removed in 1888. The remaining thirty-two trees are healthy.

REMARK.—So far in this orchard the cases of yellows have been most numerous on the east side next to the woods. On account of a very slight inclination of the field toward the east the controls have not been replowed. Their surface is now packed rather hard from recent heavy rains and there is no reason to think that the soil containing the fertilizers will be washed from one plat to another.

First result (September 5, 1889).—There are no clearly defined new cases, but two trees resemble the suspects on XLVI and XLVII.

Second result (October 8, 1890).—The two suspicious trees now have yellows, and there are twelve new cases, *i. e.* just as many as on XLVII.

Third result (October 6, 1891).—The old cases have not recovered and there are fourteen new cases. Four of the latter are cases which developed after October 8, 1890, and prior to April 15, 1891. Four trees only are still healthy.

Fourth result (October 10, 1892).—Three new cases.

EXPERIMENT XLVIII.

Preliminary examination (May 9, 1889).—This plat is next east of the twenty-second control and much like it, but composed of rather darker, mellower loam, except the extreme north end which slopes toward a ravine and has washed. There the trees are smaller and the soil poorer.

Originally there were forty trees in a rectangle 4 by 10, but eleven contracted yellows in 1888 and were removed. The remaining twenty-nine trees are healthy.

First treatment (May 11, 1889).—Each tree was dosed as follows: Dissolved bone ash, 3 pounds; muriate of potash, 2 pounds. These substances were scattered evenly under the branches, so that about two-thirds of the earth surface was covered. They were plowed down the same day about 3 inches.

First result (September 5, 1889).—Five new cases, including one doubtful.

Second treatment (May 13, 1890).—Each tree received 10 pounds of the following mixture:

	Pounds.
Dissolved bone ash (15 per cent soluble and available P_2O_5)	6
Muriate of potash (50 per cent K_2O)	4

This was sowed evenly under the branches of each tree and somewhat beyond, covering nearly the whole surface of the plat. It was plowed down at once about 3 inches. One additional tree appears to be diseased.

Second result (October 8, 1890).—The doubtful case of 1889 is now plainly diseased; the old cases are worse than last year, and there are eighteen new cases, including the case discovered this spring. This plat is worse than the control. Only six trees remain healthy.

Third treatment (April 21, 1891).—Each tree received 10 pounds of the same mixture as last year, *i. e.* 6 pounds of dissolved bone ash and 4 pounds of muriate of potash, equivalent to 804 pounds of the bone ash and 536 pounds of the muriate per acre. This was sowed evenly from the trunk outward to beyond the spread of the branches, so that the whole surface was covered, excepting some vacant places. It was ploughed down at once about 3 inches.

Third result (October 6, 1891).—Five of the six healthy trees have become diseased. None of the old cases have recovered. All are gradually dying. This experiment may be compared with the twenty-second control. Each tree has received a total of 10 pounds of muriate of potash and 15 pounds of dissolved bone ash.

Fourth result (October 10, 1892).—Some doubt as to whether the remaining tree is healthy.

EXPERIMENT XLIX.

Preliminary examination (May 9, 1889).—East of XLVIII, *i. e.* between that rectangle and the woods, is a triangular plat which originally bore sixteen trees. There were six cases of yellows in 1887, and all but one of the remainder succumbed in 1888. All but seven have been removed, of which number only one is healthy.

The soil slopes gently towards the east and northeast, and is a mellow loam, somewhat looser and darker colored than the soil on the west end of the orchard, but there is no abrupt transition. For this experiment three diseased trees were selected on the north end on a gentle slope.

First treatment (May 11, 1889).—The first tree received 8½ pounds of muriate of potash and 11 pounds of dissolved bone ash. The second and third each received 5 pounds of muriate of potash and 6 pounds of dissolved bone ash. The fertilizers were sowed evenly under the branches and plowed down at once. The first and third were pruned by the removal of several large limbs, *i. e.* about one-half of each tree, the best-looking portions being left. The other tree was left unpruned. They are now alive in all parts, but unquestionably diseased.

First result (September 5, 1889).—No improvement. The three trees are worse than last year and very sickly. The shoot-axes have made only a feeble growth, and all of the foliage is reddish or yellowish, and much dwarfed and curled. The tree which was not pruned looks feeblest.

REMARK.—No further treatment.

Second result (October 8, 1890).—The first tree is nearly dead; the unpruned one is dead; and the third is nine-tenths dead.

TWENTY-THIRD CONTROL.

Preliminary examination (May 11, 1889).—Three diseased trees on the same plat, and not far from the three treated ones, and are reserved for comparison. They are diseased in all parts, but there is no choice between them and the treated ones.

First result (September 5, 1889).—The trees are worse than last year, but not worse than those which were dosed with dissolved bone ash and muriate of potash. There is no marked difference in any of these six trees.

Second result (October 8, 1890).—The trees are still alive in some part, but very feeble, not worse, however, than those which were treated.

REMARK: *September 5, 1889.*—A very handsome, healthy, vigorous tree which stood alone on the same plat has become diseased. It looked so well in 1888 and the spring of 1889 that my attention was drawn to it especially. The trees on three sides of it became diseased in 1888 and were removed, and the trees to the west of it, on XLVIII, are still healthy.

October 8, 1890.—The vigorous tree is still diseased but not yet a bad case.

October 6, 1891.—This tree is much worse than last year, and becoming feeble. It was cut down in the fall of 1891 so that its trunk and roots might be examined.

GENERAL REMARKS.

1889: *Spring.*—The early spring was very rainy. The soil of the whole orchard had been plowed some weeks previous to the treatments and was in good condition.

September 5.—The season from April to August was excessively rainy. Prior to July the orchard was cultivated as frequently as the rains would permit, and was replowed in midsummer. There was no fruit beyond here and there a peach. The trees dosed with dissolved bone ash and muriate of potash look better than those which received dissolved bone ash and kainit. On the trees reserved for control the foliage is comparatively scanty, and is now yellowish and nearly ready to drop, or has already fallen.

1890: *May 13.*—Owing to the mild winter and early spring, vegetation is quite advanced. Cherries are one week in advance, and pears about two weeks. Peaches are far ahead of last year. Diseased trees blossomed in February, and the healthy trees as early as March 3. Peach foliage is now growing vigorously. The terminal shoots are 1 to 3 inches long, and their basal leaves are 3 to 4 inches long. The few scattering peaches are as big as hazelnuts. The fertilizers fell upon a level surface bearing a scattering growth of clover, grass, and weeds, and were at once plowed down. This was the first plowing of the season. Part of the controls were plowed the same day, and the remainder as soon as the weather permitted.

October 13.—The orchard was plowed only once, but received three or four cultivations between May and August. It is now nearly free from grass and weeds.

The meteorology of this side of the Peninsula differed considerably from that of Delaware. Rains occurred at frequent intervals throughout the season, and there was no protracted drought.

The results of two years' treatments are very unpromising. This is especially true of the treatments with dissolved bone ash and muriate of potash. Plat XLVI, dosed heavily with dissolved bone ash and excessively with kainit, is the only one that has developed no new cases. This, however, is probably accidental, because it received less actual potash than XLVII or XLVIII, and because the results on XVII (Series II) are contradictory; *i. e.*, twenty-four cases this year out of a possible thirty.

1891: *April 15.*—The trees are in full blossom. Some are now affected which showed no symptoms last fall.

April 21.—For two years in succession the furrows have been turned in, heaping up the earth toward the trees. This year they were turned away.

July 23.—The foliage is a lively green except on diseased trees. Many of the trees in this orchard now bear premature fruit, and the outlook for a good crop and for the permanency of the orchard is gloomy. All varieties have fruited abundantly. The orchard has been cultivated as usual.

October 6.—The orchard bore a large crop, five or six baskets per tree. The shoots of the season have ripened well. The greater part of the foliage has fallen, and the rest is yellowing. There is now no visible difference between the amount or color of foliage on the treated plats and the controls except that the one tree on XLVII, which received special treatment, including nitrogen, still bears green foliage.

The plats dosed with kainit both developed cases this year, but the three plats nearest to the woods were most badly affected.

October 8.—From three-fourths to nine-tenths of the leaves have fallen. Most remain on Plat XLV. The other plats are much alike.

October 23.—The orchard has been bare of foliage for some days. There have been three light frosts. So many trees are now affected that most of the orchard has been cut down, and its present appearance is that shown on Plate III.

1892: *July 13.*—The orchard was plowed last spring at the usual time, and has been kept in nice order. Thirty-two new cases. Spring cold and backward. Weather dry for some weeks.

October 10.—Nineteen trees which appeared to be entirely healthy in July now show plain symptoms: Among the weeds observed in this orchard this year are, dock, burdock, poke, yarrow, plantains (*P. rugelii*, *P. virginica*), carrot, fleabanes (*E. canadensis*, *E. annuus*), pennyroyal, evening primrose, ragweed, amaranths, *Chenopodium album*, *Xanthium strumarium*, *Asclepias cornuti*, *Acerates viridiflora*, *Polygonum persicaria*, *Allium vineale*, and *Setaria viridis*.

No fruit this year, and, therein, renewed evidence that yellows is not induced by overbearing.

The foliage is yellowing and falling rather early this autumn. It is all off some varieties, while others hold one-quarter to one-half. There have been no hard frosts. Tomato vines on this hill are still green and thrifty.

SERIES V.—ORCHARD OF DR. W. S. MAXWELL, STILL POND, MD.

(Plate XXVI.)

This orchard is immediately south of Series IV in the same field, and might have been considered with it, except that the trees are one year younger.

It is four rows wide (north and south) and twenty-four rows deep. The trees came from the nursery of R. G. Nicholson, Chestertown, Md., and were set in November, 1885. The distance apart was 18 by 18 feet.

The orchard consists of two varieties of two rows each—Salway on the north and Newington on the south. Neither has borne any fruit.

The trees received the same cultivation and treatment as Series IV and grew well from the start, so that at the commencement of the experiments they were healthy, thrifty, and of very uniform size, the trunks and branches being very smooth and free from injuries of any kind.

For treatment the block was divided into six plats, numbered from the lane eastward toward the woods, and crossing the varieties at right angles.

Originally there were ninety-six trees, but two disappeared prior to 1889, being probably removed in 1888 on account of yellows. In the spring of 1889 all but two of the trees were healthy. One was suffering from yellows or some disease which much resembled it, and the other was not quite free from suspicion.

The soil is similar to that on Series IV. The surface is level except that toward the east end. The strip is crossed diagonally by a narrow shallow gutter, extending into a ravine in the woods. Along the edges of this gutter the soil has washed away.

EXPERIMENT L.

Preliminary examination (May 9, 1889).—This plat contains sixteen trees in a square. All are healthy.

First treatment (May 9, 1889).—Each tree was dosed with the following: Dissolved bone ash (15 per cent soluble and available P_2O_5), 3.4 pounds; muriate of potash (50 per cent K_2O), 2 pounds. The fertilizers were sowed evenly around each tree, and far enough beyond the spread of the branches to cover nearly or quite the whole surface. They fell upon earth plowed some weeks previous, and were plowed down the same day to a depth of 3 to 4 inches.

First result (September 5, 1889).—All are healthy.

Second treatment (May 13, 1890).—Each tree received 11 pounds of the following mixture:

Dissolved bone ash (15 per cent soluble and available P_2O_5) . . pounds . .	7
Muriate of potash (50 per cent K_2O) . . . . do . .	4

This was sowed from the trunk outward to beyond the spread of the branches, nearly the whole surface of the plat being covered. It was plowed down at once about 3 inches.

Second result (October 8, 1890).—All are healthy. The wood is well ripened. Over two-thirds of the foliage has fallen and the rest is yellowing.

Third treatment (April 21, 1891).—Each tree received 11 pounds of the same mixture as last year. This was distributed in circles from the trunks outward, so that nine-tenths of the whole surface was covered. It was plowed down at once 3 to 4 inches.

Third result (October 6, 1891).—There are now four cases of yellows although the plat has received three doses of dissolved bone ash and muriate of potash and was under treatment more than two full years before the first case appeared.

Fourth result (October 10, 1892).—Three new cases.

TWENTY-FOURTH CONTROL.

Preliminary examination (May 9, 1889).—This plat is like the preceding. It contains sixteen trees in a square. All are healthy except one, which probably has yellows.

First result (September 5, 1889).—The tree which was suspicious now has genuine yellows. The other trees are healthy.

Second result (October 8, 1890).—No new cases. The season's shoots are well ripened, and about one-half of the foliage has fallen.

Third result (October 6, 1890).—Two new cases—*i. e.*, one-half as many as on the treated plat.

Fourth result (October 10, 1892).—Five new cases.

Experiment LI.

Preliminary examination (May 10, 1889).—This plat contains sixteen trees in a square. All are healthy. The character of the soil and general appearance of the trees are like the preceding. The field has been plowed for some weeks.

First experiment (May 10, 1889).—Each tree was dosed as follows: Dissolved bone ash (15 per cent soluble and available P_2O_5), 3 pounds; muriate of potash (50 per cent K_2O), 2 pounds. The fertilizers were sowed in the same manner as on plat L, and were plowed down the same day to a depth of 3 to 4 inches.

First result (September 5, 1889).—All are healthy.

Second treatment (May 13, 1890).—Ten pounds of the following mixture was sowed evenly around each tree, nearly the whole surface being covered:

Dissolved bone ash (15 per cent soluble and available P_2O_5)	pounds	6
Muriate of potash (50 per cent K_2O)	do	4

This was at once plowed down about 3 inches.

Second result (October 8, 1890).—All remain healthy. The shoots of the season are well ripened. Over two-thirds of the leaves have fallen and the remainder are yellowing.

Third treatment (April 21, 1891).—Each tree received 10 pounds of the same mixture as last year. This was weighed out and distributed under the branches and outward evenly, covering about nine-tenths of the whole surface of the plat. It was plowed down at once about 3 inches.

Third result (October 6, 1891).—No cases. This result, however, is probably accidental, since plat L has given a contradictory one.

Fourth result (October 10, 1892).—Nine cases, the first on this plat.

Experiment LII.

Preliminary examination (May 10, 1889).—Originally this plat contained sixteen trees in a square, but one has been removed, probably on account of yellows. All are healthy. The soil and general appearance of the trees may be compared with the plats already described.

First treatment (May 10, 11, 1889).—Each tree was dosed with the following: Dissolved bone ash (15 per cent soluble and available P_2O_5), 3 pounds; nitrate of potash (13 per cent N), 2 pounds.

The dissolved bone ash was sowed in morning of May 10, and at the same time the nitrate was sowed around six trees on the west side. In the afternoon came a sudden high wind followed by rain. This blew away some of the finer bone ash, perhaps one-fifth to one-fourth. The remainder of the nitrate was put on May 11, and the whole was then plowed down 3 or 4 inches. The fertilizer was sowed in the same manner as on the other plats, and the previous treatment of the soil had been the same.

First result (September 5, 1889).—All are free from distinct symptoms of yellows, and yet one tree, in the northwest corner, is not quite healthy.

Second treatment (May 13, 1890).—Six pounds of dissolved bone ash and four pounds of nitrate of potash were sowed separately around each tree outward to beyond the spread of the branches, and were plowed down at once about 3 inches.

Second result (October 8, 1890).—The unhealthy tree is now diseased by yellows. The rest are still healthy. The trees on this plat have made one-half more growth than those on the twenty-fifth control. Many of the terminal shoots have grown over 2 feet, and most of them over 1 foot. The leaves are also larger and greener than on 25 or those on L and LI. There is still much green foliage on the tops of the trees.

Third treatment (April 21, 1891).—Each tree received the same treatment as last year—*i. e.*, 6 pounds of dissolved bone ash (15 per cent of soluble and available P_2O_5), and 4 pounds of nitrate of potash (12 per cent N). The mixture was weighed out for each tree. The whole surface of the plat was covered, except the vacant place.

Third result (October 6, 1891).—There are two new cases, one of which developed between October 8, 1890, and April 15, 1891.

Fourth result (October 10, 1892).—Twelve new cases.

TWENTY-FIFTH CONTROL.

Preliminary examination (May 10, 1889).—This plat contains sixteen trees in a square. All are healthy. The plat is crossed by a shallow gutter, exposing some of the roots of one or two trees. The soil is like the last.

First result (September 5, 1889).—All healthy.

Second result (October 8, 1890). All healthy. In comparison with experiment LII these trees seem stunted. The terminal growths are 6 to 12 inches long, rarely 15 inches. The wood is well ripened and nearly all of the leaves have fallen.

Third result (October 6, 1891).—One case of yellows which appeared between October 8, 1890, and April 15, 1891.

Fourth result (October 10, 1892).—Eight new cases.

EXPERIMENT LIII.

Preliminary examination (May 10, 1889).—Originally this plant contained sixteen trees in a square, but one has been removed. All are healthy, unless it be the northeast corner tree, which does not look quite right.

First treatment (May 11, 1889).—Each tree was dosed with 2 pounds of nitrate of potash. This was sowed evenly around the trunks and outward to beyond the spread of the branches. It was plowed down the same day to a depth of 3 to 4 inches.

First result (September 5, 1889).—The northeast tree is almost certainly diseased by yellows, and another tree in the east row is suspicious. The rest are healthy.

Second treatment (May 13, 1890).—Four pounds of nitrate of potash were distributed evenly around each tree to beyond the spread of the branches, nearly the whole surface of the plat being covered. It was plowed down at once about 3 inches.

Second result (October 8, 1890).—The two suspicious trees now show plain symptoms of yellows. There are also ten new cases. Only three trees remain healthy. The treated trees have made a much larger growth than those on the controls.

REMARK.—This unexpected result agrees with the results observed in orchards IV and VII, the trees next to the forest having become affected sooner than the others.

Third treatment (April 21, 1891).—Each tree received 4 pounds of nitrate of potash (12 + per cent N.). This was sowed evenly in a circle around each tree, about four-fifths of the whole surface of the plat being covered. It was plowed down at once about 3 inches.

Third result (October 6, 1891).—There are three new cases, all of which appeared between October 8, 1890, and April 15, 1891. The old cases are much worse than last year. Every tree is now diseased.

REMARK.—Two untreated trees on the east side of this plat remained healthy until the summer of 1890.

GENERAL REMARKS.

1889: *Spring.*—The soil was plowed some weeks previous to treatments. The fertilizers were all plowed down shallow as soon as sowed. The field received several cultivations, and one additional plowing in midsummer to destroy the weeds, their growth being rank on account of the prolonged rainy weather.

September 5.—No new cases developed, and comparatively few cases of yellows appeared this year anywhere in the vicinity of Still Pond. The plat dosed with dissolved bone ash and nitrate of potash made the most growth and presented the most attractive appearance. The plat dosed with nitrate of potash alone, looked not quite so well, but better to the untrained eye than those which received bone and muriate of potash. On the treated trees there is more foliage than on the controls and it is greener. Those dosed with bone ash and nitrate of potash have fully one-third more foliage surface and a much greater growth of shoot axes, and very few of their leaves have yet fallen or turned yellow.

The orchard bore no fruit beyond here and there a peach. The ripening of these peaches has been retarded noticeably on the treated portions. The Newington is now fully ripe on the untreated plats, but it is green and hard on the treated ones, so that none are fit to eat.

October 31.—The trees which had nitrate of potash still hold a good many green leaves, one-quarter to one-third perhaps. Most orchards are now bare.

1890: *May 13.*—The remarks on time of blossoming and size of the foliage under Series IV apply also to this orchard. This orchard bears a few scattering peaches, which are now about the size of large filberts.

October 8.—There was no fruit this year. The orchard was cultivated three or four times during the summer and is now free from weeds.

1891: *April 21.*—The orchard began to blossom about April 12 or 13, and was in full blossom on April 15. The soil was in good condition, and the fertilizers were sowed in still air and plowed down at once.

July 23.—The whole orchard looks well and is full of fruit.

September 30.—The last of the Salways were picked to-day—a few belated fruits. The bulk of the crop ripened some days ago.

October 6.—Where nitrogen was used, this orchard still shows the effect of treatment. It remains quite healthy except near the forest.

October 8.—The proportion of leaves still retained by the trees on the different plats is about as follows: L, $\frac{1}{5}$; 24, $\frac{1}{5}$; LI, $\frac{1}{5}$; LII, $\frac{1}{3}$ to $\frac{1}{2}$; 25, $\frac{1}{10}$ to $\frac{1}{5}$; LIII, $\frac{1}{4}$.

October 23.—The trees are bare of foliage, except on the nitrated plats, where the tops still hold some green leaves.

1892: *October 10.*—No fruit. The orchard was plowed in the spring and cultivated as usual. It is not very weedy. Two more cases than at the midsummer examination.

Series VI.—Orchard of Dr. W. S. Maxwell, Still Pond, Md. (Plate xxvii.)

This orchard is in the same field and joins Series V on the south. The trees came from the nursery of R. G. Nicholson, Chestertown, Md. They were set in November, 1886, at a distance apart of 18 by 19 feet. The orchard is thirteen rows wide (north and south) and a variable number of rows in depth, being longest on the north side (twenty-one rows). It consists of six varieties, as follows, counting from north to south: Early Rivers, St. John, Reeves, Walkers Variegated Free, Beers Smock, and McAllister. Five trees are now missing, but I think none of them were removed on account of yellows. They are very free from borers and bark injuries or dead limbs. All are free from symptoms of yellows and are uniform, fine-looking trees. None have borne any fruit.

The orchard has been divided, for treatment, into five sections, crossing the varieties at right angles, and numbered from the farm lane eastward toward the woods.

In the northeast corner near the woods there is a gutter or shallow end of a ravine in which the soil is a stiff, reddish, ferruginous clay.* There is also a little of this stiff, yellowish-red, and poor soil on a very gentle incline on the south side, including about seventeen trees, as shown on the map. Otherwise the soil is a level clay loam of good quality, and just like the middle and west parts of orchards IV and V.

EXPERIMENT LIV.

Preliminary examination (*May 9, 1889*).—This plat is on the west side, next the farm lane. It contains fifty-two healthy trees in a rectangle 4 by 13.

First treatment (*May 9, 1889*).—Each tree was dosed as follows: Dissolved bone ash (15 per cent soluble and available P_2O_5), 3.4 pounds; nitrate of potash (13 per cent N), 2 pounds. These substances were sowed evenly under each tree-top, outward to considerably beyond the spread of the limbs, so that nearly or quite the entire surface was covered. They were plowed down the same day to a depth of about 3 inches. The soil had been plowed for some weeks.

First result (*September 5, 1889*).—There are no cases, and the trees are remarkably vigorous. In comparison with the control these trees have fully one-third, if not one-half, more foliage surface and twice as much growth of shoot-axes, and very few of their leaves have yet fallen or turned yellow. The foliage of these trees is a luxuriant dark green, and it is very smooth and free from parasitic fungi, except Saccardo's *Cercosporella persicæ*, which plentifully frosts the under surface of many leaves, especially on the lower branches and in the shaded interior. On these trees I have seen none of the shot-hole or leaf-spot disease (*Cercospora circumscissa*) which is present on the untreated blocks and is frequent this year everywhere, especially on the foliage of trees diseased by yellows.

REMARK.—The plats under treatment in these hill-top orchards look very thrifty and beautiful, and have been the subject of frequent remark during the summer. This is especially true of those which received the dissolved bone ash and nitrate of potash.

Second treatment (*May 13, 1890*).—Each tree received 3.5 pounds of dissolved bone ash and 2 pounds of nitrate of potash. These were sowed separately and evenly under the branches, so that about two-thirds of the whole surface of the plat was covered. They were plowed down at once about 3 inches.

Second result (*October 4, 1890*).—Three well-marked cases of yellows have appeared, the trees being seriously affected. One healthy tree was broken down by the wind.†

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* This compact red clay probably forms a thick stratum under all of the orchards on this hill, and here comes to the surface on account of washing.

† Owing to the great weight of foliage, high winds injured a number of trees on the nitrated blocks.

The others are sound and are pictures of health, but fewer leaves and less active assimilation would be preferable at this time of year. The growth has been extraordinary. During the last two years the trees on this plat have become so much larger than those on the twenty-sixth control that they seem to be one year older. The foliage is still as smooth and green as it was in July. Very few leaves have fallen. Those that remain are so large and so numerous that it is difficult to see through the crown of the tree, and the growth has been so great that branches of neighboring rows nearly touch. As in 1889, there is a great abundance of *Cercosporella persicæ* Sacc. on the lower surface of the inner and more shaded leaves. The foliage is very smooth and free from *Cercospora circumscissa*, or other shot-hole fungi.

October 9, 1890.—On Plate IV a single tree is contrasted with one from the neighboring control, and a double row of the treated trees is shown on Plate V.

Third treatment (*April 21, 1891*).—Each tree received 6 pounds of a mixture consisting of 4 pounds of dissolved bone ash (15 per cent of soluble and available P_2O_5) and 2 pounds of nitrate of potash (12 per cent N). The mixture was weighed out and sowed evenly outward from the trunks, so that nineteen-twentieths of the whole surface was covered. The trees were nearly done blossoming. The Early Rivers blossomed two or three days later on this plat than on the others. The appearance of the orchard three days after this date is shown on Plate VI.

Third result (*October 6, 1891*).—Six new cases, one of which belongs to the period between October 8, 1890, and April 15, 1891. The old cases are worse than last year.

Fourth result (*October 10, 1892*).—Twenty new cases.

TWENTY-SIXTH CONTROL.

Preliminary examination (*May 10, 1889*).—This plat is next east of LIV. The trees are of the same size and general appearance, and the soil is of the same character, except a small strip on the south end, as already noted. Originally there were fifty-two trees in a rectangle 4 by 13, but two have disappeared. All are healthy. The soil was plowed some weeks ago, but not again at this time.

First result (*September 5, 1889*).—No cases. The trees are healthy, but in striking contrast with those on plat LIV. There is less growth of new wood and foliage, and the latter is of a lighter green than on the treated trees.

Second result (*October 4, 1890*).—Two cases of yellows—*i. e.*, one less than on LIV. The trees have made much less growth, but enough. They are good-looking trees, but they bear much less foliage than those on LIV, and the leaves are neither so large nor so dark a green. See Plate VII, which is strictly comparable with Plate V.

Third result (*October 6, 1891*).—Three additional cases of yellows, two of which belong to the period between October 4, 1890, and April 15, 1891.

Fourth result (*October 10, 1892*).—Twenty new cases—*i. e.*, just as many as on plat LIV.

EXPERIMENT LV.

Preliminary examination (*May 10, 1889*).—This plat is next east of the twenty-sixth control. The trees are of the same size and general appearance, and the soil is of the same character. Originally there were fifty-two trees in a rectangle 4 by 13, but one has disappeared. All are healthy.

First treatment (*May 10, 1889*).—Each tree received 3 pounds of dissolved bone ash and two pounds of muriate of potash. This mixture was sowed as on LIV, and was plowed down the same day to a depth of about 3 inches.

First result (*September 5, 1889*).—No cases. All the trees are healthy and somewhat more vigorous than those on the twenty-sixth control, but are not strikingly different, nor are they entirely uniform like those on LIV and LVI. Some trees on the south end have not made a very fine growth.

Second treatment (*May 13, 1890*).—Each tree received the following mixture:

Dissolved bone ash (15 per cent of soluble and available P_2O_5), pounds	3
Muriate of potash (50 per cent K_2O) do	2

This was sowed evenly under the branches, so that about two-thirds of the whole plat was covered. It was plowed down at once about 3 inches.

Second result (*October 4, 1890*).—Two cases of yellows have appeared. The rest of the trees are healthy. These trees have made a good growth and now bear more and greener foliage than the older trees of Series IV and V, dosed with bone and muriate of potash, or with bone and kainit. They are much less green and rank-growing, however, than those on Plats LIV and LVI, which received bone and nitrate of potash. Although not strikingly different from those on the twenty-sixth control, there is some difference in favor of the treatment.

Third treatment (*April 21, 1891*).—Each tree received 6 pounds of the following: Dissolved bone ash, 4 pounds; muriate of potash, 2 pounds. This mixture was weighed out carefully, and was evenly distributed from the trunks outward, so that about nineteen-twentieths of the whole surface was covered. It was plowed down at once about 3 inches.

Third result (*October 6, 1891*).—Six new cases. Three of these belong to the period between October 4, 1890, and April 15, 1891. The rest of the trees look well.

October 14, 1891.—Plate VIII shows the size and general appearance of these trees at this date

Fourth result (*October 10, 1892*).—Twenty-three new cases.

EXPERIMENT LVI.

Preliminary examination (*May 10, 1889*).—This plat is next east of LV. Originally there were fifty-one or fifty-two trees, but only fifty remain. All are healthy, and very similar to those already mentioned. The soil is the same, except as already stated.

First treatment (*May 10 and 11, 1889*).—Each tree on this plat received 3 pounds of dissolved bone ash and 2 pounds of nitrate of potash. A little less bone ash was used, but in other respects the treatment was a duplicate of Plat LIV. The dissolved bone ash was sowed May 10. The nitrate had also been put around the trees on the west one-half when a heavy wind and rain storm drove the men out of the orchard and stopped work. Some of the bone ash blew away, but not over one-fifth to one-fourth. The remainder of the nitrate was sowed next day, at which time it was all plowed down to a depth of about 3 inches. The plat had already received one plowing.

First result (*September 5, 1889*).—No cases. All of the trees are healthy and every one bears a great abundance of vigorous-looking, dark-green, unspotted foliage. This block and LIV (same treatment) are beautiful to look upon. They have responded to the fertilizers promptly and very vigorously.

Second treatment (*May 13, 1890*).—Each tree received 3 pounds of dissolved bone ash (15 per cent of soluble and available P_2O_5) and 2 pounds of nitrate of potash (13 per cent N.). These substances were sowed separately and evenly under the branches, so that about two-thirds of the whole surface was covered. They were plowed down at once about 3 inches.

Second result (*October 4, 1890*).—There are two cases of yellows. The rest are free from disease. These trees have made a rapid and prolonged growth, and look like those on Plat LIV. They are covered with a dense growth of large, smooth, dark-green, and active leaves. The trees on control No. 27 look very feeble and stunted in comparison.

Third treatment (*April 21, 1891*).—Each tree received 6 pounds of the following mixture: Dissolved bone ash, 4 pounds; nitrate of potash, 2 pounds. This was weighed out and distributed from the trunks outward, so that about nineteen-twentieths of the whole surface was covered. It was plowed down at once about 3 inches.

Third result (October 6, 1891).—Thirteen new cases, seven of which belong to the period between October 4, 1890, and April 15, 1891.

October 14, 1891.—The general appearance of these trees at this date is shown on Plate IX. This block has recently dropped many leaves. Two weeks ago it looked much like the double row shown on Plate V.

Fourth result (October 10, 1892).—Twenty-three new cases.

TWENTY-SEVENTH CONTROL.

Preliminary examination (May 10, 1889).—This plat is east of the one last described. It consists of a triangle, and bears only thirty-six trees, the forest encroaching on the southeast side. One tree is missing. Those that remain are healthy. The soil, except on the extreme north end, is much like that already described, or a very little stiffer. It has been plowed some weeks.

First result (September 5, 1889).—No cases. All of the trees are healthy, but they have made only a very moderate growth. By comparison with Plats LIV and LVI, or even with Plat LV, or the twenty-sixth control, this block of trees looks starved and very indifferent, but there are no diseased trees. It has simply made much less growth, and that growth is now nearly completed. On the contrary, the nitrated trees are still full of green foliage, and look as if they would grow until frost cuts them. The trees on this control have not produced one-half as much foliage surface or new wood as those on Plats LIV and LVI, and the leaves are yellow or have already fallen.

Second result (October 4, 1890).—The remarks of last year apply again. The trees are so much smaller than those on LVI that they might pass for an orchard two years younger. They have not produced over one-third as much leaf surface or new wood. The shoots of the season are well ripened. Two-thirds of the leaves have fallen and the remainder are yellowing. The contrast is very striking. One tree is gone (wind?) and there is one case of yellows. The rest are healthy. The forest has not yet exerted any evil influence. Will it do so next year?

Third result (October 6, 1891).—Eleven new cases, including one doubtful. Four of these cases belong to the period between October 4, 1890, and April 15, 1891. The same remarks as last year apply to the difference in size, amount of foliage, and time of maturity of shoots. A majority of the trees next to the forest have succumbed (see Plate XXVII).

Fourth result (October 10, 1892).—Seven new cases. The suspect of last fall is healthy.

GENERAL REMARKS.

1889: *Spring.*—This orchard was plowed some weeks prior to the application of the fertilizers. They were plowed down at once, but the controls were not replowed at this time.

September 5.—The whole orchard was plowed again in midsummer and was cultivated several times during the season. The plats under treatment look very thrifty and beautiful and have been the subject of frequent remark during the summer. All of the nitrated trees are still remarkably green and thrifty; the muriated ones look well, but are distinctly less green and vigorous. Many of the trees on the twenty-sixth control look as well as those on Plat LV. The block which has made least growth and now looks yellowest (autumn ripeness) is the twenty-seventh control. Every tree treated with nitrate of potash and dissolved bone ash responded by a vigorous growth of shoots and large, dark-green leaves. The transition from the treated to the untreated rows is very sudden as regards not only size, color, quantity, and persistency of foliage, but also the amount of new wood produced.

The difference between Plat LV and the twenty-sixth control is least striking. All of the trees look well, but those on the treated plat are a little more vigorous, especially on the north end.

October 31.—All of the trees are now bare, except the nitrated ones, which still hold a considerable sprinkling of green leaves, there having been no severe frost. There are no cases of yellows and the experiments have at least one year's start of the disease. The orchard bore no fruit.

1890: *May 13.*—The orchard unfolded its blossoms and leaf buds very early, on account of the mild winter and unusual spring. The fertilizers were sowed and plowed down the same day. Part of the controls were plowed at this time, and the remainder as soon as the weather permitted. This was the first plowing of the season.

October 13.—The orchard was cultivated three or four times, *i. e.*, up to the first of August, and is now nearly free from grasses and weeds. It bore no fruit. As last year, the block which has made least growth is the twenty-seventh control, on the triangle next to the woods. Also, as last year, the difference between Plat LV (muriate and bone) and the twenty-sixth control is not as striking as might have been anticipated, although the treated plat is the better. Ten cases of yellows have appeared, but they are distributed without reference to treatments (see Plate XXVII).

October 22.—The nitrated trees have dropped thousands of leaves during the last two weeks, and, except in size, the difference between them and the controls is less striking than it was, although still apparent. Most of the orchards around Still Pond, except some young and overstimulated ones, are now leafless or nearly so.

REMARK.—This field, like the Fulton orchard, Series XIV, is least abundantly furnished with nitrogen. Supply that, and the trees grow luxuriantly; withhold it, and they make only a moderate growth, even when dosed with great quantities of bone and potash. However, the addition of much nitrogen sensibly retards the maturity of the season's growths, and is likely to prove injurious rather than beneficial.

1891: *April 21.*—The orchard is just done blossoming. The fertilizers were sown in still air and plowed down at once. The furrows were turned away from the trees (see Plate VI), having been plowed toward them in 1889 and 1890. The controls were plowed at the same time.

July 23.—All varieties bear fruit and the Early Rivers is greatly overloaded, the fruit being small, badly spotted by *Cladosporium carpophilum*, and of inferior quality.

September 30.—The trees on Plats LIV and LVI (dissolved bone a h and nitrate of potash) ripened their fruits about a week later than those on the controls. The peaches on the muriated block ripened early.

October 6.—The effect of treatment is still plainly visible on Plats LIV and LVI in green foliage, but not on LV. The trees on that look about like those on the twenty-sixth control. The trees on the twenty-seventh control are still much smaller than any others in this orchard. All of the varieties bore a very moderate crop of fruit, about one-half basket per tree, except Early Rivers. The trees of this variety bore from five to eight times as much fruit as the others, and yet there was no excess of yellows in this variety.*

At the close of the third year's treatment there comes a large increase of yellows—thirty-nine cases altogether. Two-thirds of the cases are on that one-third of the orchard nearest to the forest.† All of the plats have been attacked, the one still freest from disease being the twenty-sixth control. There are also a disproportionately large number on the south side, on the stiff, poor soil already mentioned (see map).

October 8.—The relative amount of foliage remaining on the different blocks is about as follows: LIV, ½ to ⅔; 26, ½; LV, ½; LVI, ½; 27, $\frac{1}{10}$ to ½.

October 23.—The amount of foliage remaining on these trees is as follows: The north two varieties are bare; the middle three varieties hold about one-quarter as many leaves as on October 8; the south variety is about midway between the others in leafiness. On the middle three varieties (six rows) the effects of treatment are still plainly visible in the leaves on the nitrated rows. The foliage remaining on LV and the controls is less abundant and is yellowing much faster.

1892: *July 13.*—Many new cases in all parts. Orchard much worse than last year. The foliage on the diseased trees has a yellowish, unhealthy look.

October 10.—No fruit this year. Twenty-three cases more than at the midsummer examination, and a greater total than any previous year.

The orchard was plowed in the spring and carefully cultivated until midsummer.

SERIES VII.—ORCHARD OF DR. W. S. MAXWELL, STILL POND, MD. (Plate XXVII.)

This orchard is immediately south of Series VI, in the same field. The trees came from Randolph Peters, Wilmington, Del. The varieties are Newington and a late cling of Smock type, the latter being on the south side. They were set in November, 1885, at a distance approximating 17½ by 18½ feet. They are of less even growth than those in Orchards IV, V, and VI.

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* Neither was there any excess of cases in this variety in 1892.

† In a 5 and 6 year old orchard of 1,200 trees on the same hill top, a few rods to the southeast, owned by Samuel Davis, and examined in 1891, nine-tenths of the 310 cases were within 6 rods of the forest, which incloses it on three sides.

Yellows was discovered in 1887 in three trees, and that summer they were badly dwarfed, as though they had been affected for some time. Certain other trees were "Frenched" as though troubled by root-aphides or not well nourished. The trees were also of less uniform size than those in the other orchards in this field. Those on the ferruginous clay were smallest. There were also eight cases of yellows in 1888.

The orchard is bounded on the east by the forest already described as covering the hillside ending in Lloyd's Creek. On the south is a level field of clay-loam used for corn and wheat. On the west is the level open pasture land already referred to in describing Series IV.

The surface inclines slightly toward the woods and the soil is not uniform, ranging from loam to rather stiff clay, and varying in color. The east half in particular (see Plate XXVII) consists of a poor stiff clay which is reddish and yellowish.

On account of the varying character of the soil, the treatments were made to conform to the direction of the varieties rather than to cross them at right angles as heretofore. This orchard was eight rows wide (north and south) and a varying number of rows in depth, the forest encroaching on the southeast corner. It was divided into four plats (numbered from north to south) for experiments with lime.

EXPERIMENT LVII.

Preliminary examination (*May 10, 1889*).—This plat consists of two rows on the north side of the orchard extending from the farm lane to the woods. There are thirty trees. One unquestionably has yellows, and two others are probably affected. The rest are healthy.

First treatment (*May 18, 1889*).—The whole surface was evenly covered with freshly slaked caustic lime at the rate of one bushel per tree, or about 135 bushels per acre. The lime was not plowed down at once, but a rain followed the sowing beating it into the earth which had been plowed some days previous and was mellow.

First result (*September 5, 1889*).—The tree which was suffering from yellows is still affected, but is not yet yellow. One of the doubtful trees is still doubtful and the other is now plainly diseased by yellows. The rest are healthy.

Second treatment (*May 13, 1890*).—Each tree was given 4.4 pounds of muriate of potash (50 per cent K_2O), equivalent to 594 pounds per acre. Four pounds were sowed evenly around each tree, and the remaining 12 pounds were scattered between the two rows, so that nearly the whole surface was covered. This was at once plowed down about 3 inches.

Second result (*October 4, 1890*).—The old cases have not recovered, the doubtful tree is plainly diseased, and there are ten new cases. A bad showing for lime and potash. The trees have felt the stimulus of the treatments and have made an excellent growth. *Oct.* 18.—On Plate X an average healthy tree from this plat is contrasted with one from the nearest control, the latter being a case of 1890.

REMARK.—The treatments were discontinued.

Third result (*October 6, 1891*).—The old cases are worse than last year. There are also thirteen new cases, including one doubtful. Four of these belong to the period between October 4, 1890, and April 15, 1891. Only four healthy trees remain, all of which are on the stiff, poor soil.

REMARK.—On one tree, October 6, there were no signs of disease except the red and yellow curled leaves which usually accompany the other symptoms in well-developed cases. The most minute scrutiny of every shoot-axis failed to show that a single winter bud had pushed, and yet it seemed reasonably certain that the tree was affected. On October 18 the tree was revisited and winter buds were then pushing. The difficulties of diagnosis are greater in some orchards than in others, but none under treatment have given much trouble. Probably the case in question could have been identified readily in August by means of premature fruit.

Fourth result (*October 10, 1892*).—The tree which was doubtful is now plainly diseased, and there are three new cases.

TWENTY-EIGHTH CONTROL.

Preliminary examination (*May 10, 1889*).—This plat consists of two rows next south of LVII. Originally there were twenty-seven trees, but one has been removed, probably on account of yellows. Two trees look very suspicious. The rest are healthy. The soil has been plowed some days.

First result (*September 5, 1889*).—One of the doubtful trees is now unquestionably diseased, and the other is still doubtful, *i. e.*, no winter buds are pushing. In addition, three of the healthy trees now have a slightly suspicious appearance.

Second result (*October 4, 1890*).—The old case is still diseased. The doubtful tree of two years' standing and the three slightly suspicious ones all have yellows and were probably affected with it from the start. There are also eight new cases, one of which is shown on Plate x, Fig. 2. The results on this strip and on LVII correspond closely, and no conclusions favorable to the treatment can possibly be drawn.

Third result (*October 6, 1891*).—Eight new cases, three of which belong to the period between October 4, 1890, and April 15, 1891. Five trees are still healthy, four of them being on the poorer soil.

Fourth result (*October 10, 1892*).—Five new cases.

EXPERIMENT LVIII.

Preliminary examination (*May 10, 1889*).—This plat is next south of the twenty-eighth control. It consists of two rows extending from the west lane to the woods. Originally there were twenty-three trees, but two have been removed on account of yellows. One tree is plainly diseased by yellows and one other is probably diseased. The rest are healthy.

First treatment (*May 18, 1889*).—The whole surface was evenly covered with freshly slaked caustic lime at the rate of one-half bushel per tree, or about 67 bushels per acre. The lime was not plowed down at once, but a gentle and then a heavy rain beat it into the earth a few hours after the sowing. The soil had been plowed some days previous to the sowing and was mellow. On both plats the lime was applied as soon as it was well slaked and cool enough to handle.

First result (*September 5, 1889*).—The diseased tree remains diseased; the doubtful tree is now unquestionably affected, and two healthy trees near this one have also succumbed. The other trees are healthy. As on LVII, there appears, if anything, to be a slight difference in favor of the lime, so far as growth is concerned.

Second treatment (*May 13, 1890*).—Four pounds of nitrate of potash were distributed evenly around each tree, and the remaining 31 pounds were divided into two nearly equal portions and sowed lengthwise of each row, making a total of over 5 pounds per tree, or 675 pounds per acre. Nearly the whole surface was covered, the only portion omitted being the middle strip between the two rows, which is now set with a row of young and small apple trees. The fertilizer was at once plowed down about 3 inches.

Second result (*October 4, 1890*).—The four old cases have not recovered, but are worse than last year, although they have made more growth. There are also two new cases. These trees have made an extraordinary growth, and are nearly as big again as those on the twenty-ninth control. They resemble those on Plat LIV (Series VI). The foliage is abundant, luxuriant, and still active, the whole crown being a dense mass of smooth, dark green leaves (see Plate XI, ignoring the background).

REMARK.—The treatment was abandoned.

Third result (*October 6, 1891*).—Eleven new cases, four of which belong to the period between October 4, 1890, and April 15, 1891. Only four trees are now healthy.

Fourth result (*October 10, 1892*).—Four new cases.

TWENTY-NINTH CONTROL.

Preliminary examination (*May 18, 1889*).—This plat is next south of LVIII, and occupies the most southern part of the field. It contains twenty trees in two rows. One is diseased by yellows and the rest are healthy. The soil was plowed some days ago, and is now in good condition.

First result (*September 5, 1889*).—The diseased tree remains diseased, and one of the healthy trees now looks slightly suspicious. The rest are healthy.

Second result (*October 4, 1890*).—The old case is worse than last year. The suspicious tree is now plainly diseased, and there are three new cases. The season's growth is much nearer to maturity than on Plat LVIII, and the trees will probably enter the winter in better condition, unless frost holds off for a month or six weeks. (See Plate XII, which is strictly comparable with XI). All of the cases are on the east end, next to the woods.

Third result (*October 6, 1891*).—Ten new cases, three of which belong to the period between October 4, 1890, and April 15, 1891. One-fourth of the trees are still healthy.

Fourth result (*October 10, 1892*).—Four new cases. One healthy tree.

GENERAL REMARKS.

1889: *September 5.*—This orchard was plowed, controls included, some days previous to the treatments. It was also plowed in early spring, and again in summer, and was cultivated several times between May and August. There is less difference between the limed strips and their controls than between the controls and treated blocks in the other orchards in this field. All of the trees, except those diseased by yellows, have made a good growth and are still full of green leaves.

There was no fruit this year.

1890: *May 13.*—The fertilizers were plowed down at once, and the controls were also plowed at this time. This was the first plowing of the season.

October 4.—The field was cultivated several times during the season. The apparent evil influence of the neighboring forest is now very noticeable. There was no fruit this year.

1891: *April 28.*—No treatments were given, but the orchard was plowed the same as the others. The young fruits have not yet burst the cap in this or neighboring orchards.

October 6.—At this date all of the plats look much alike, as regards amount and color of foliage except that the foliage on the diseased trees, especially the older cases, is unnaturally red—not only in this orchard, but also in orchards IV, V, and VI. The trees on Plats LVII and LVIII seem to have rather more foliage, and the trees on LVIII are certainly much larger than those of either control, owing to the nitrate of potash applied last year. The orchard bore abundantly—five or six baskets per tree.

October 8.—The relative amount of foliage remaining on the different blocks is about as follows: LVII, $\frac{1}{3}$; 28, $\frac{1}{5}$; LVIII, $\frac{1}{3}$; 29, $\frac{1}{4}$.

October 23.—This orchard still bears some leaves, especially the block which was nitrated last year. Most of the foliage is yellowing and reddening. The separative layer in the petiole has been formed some weeks and the leaves come away easily.

1892: *July 13.*—This orchard was plowed in the spring and has been carefully cultivated. No fruit this year.

October 10.—Sixteen cases this year; five since July 13.

SUMMARY.

The orchards described under IV to VII constitute practically one body of trees, being in the same field and subject to similar physical conditions. The results are therefore presented under one head.

When the treatments began, the youngest orchard, VI, was entirely free from yellows, and remained free for a whole year, *i. e.*, until after the second treatment. On IV the disease had already made considerable inroads at the beginning of the treatments. On V and VII it had made little progress. In other words, the oldest orchard was most affected and the youngest one was entirely free, while the other two, midway between these in age, also occupied an intermediate position as regards freedom from disease.

In 1889 the effect of the fertilizers was distinct on all of the plats except those dosed with lime. In 1890 each plat distinctly showed the effects of the treatment. In 1891 the same was true of all which received treatment, *i. e.*, all but Series VII. Many people saw these trees, and there can be no dispute on this point. The photographs also bring out the effect of the fertilizers very plainly.

The cases, by years, in these orchards from the first appearance of the disease are as follows:

TABLE XXI.—*Showing number of trees, when planted, cases of yellows by years, etc., in Orchards IV–VII of Dr. W. S. Maxwell, Still Pond, Md.*

Series.	Trees.		Cases, by years.							
	When planted.	Number planted.	1887.	1888.	1889.	1890.	1891.	1892.	Total.	Per cent.
IV	Nov., 1884	256	9	35	8	64	61	52	229	89.45
V	Nov., 1885	98	2	2	0	14	12	37	67	68.37
VI	Nov., 1886	244	0	0	0	10	38	93	141	57.79
VII	Nov., 1885	100	3	8	6	23	42	16	98	98.00

The per cent of cases, by years, figured on the total healthy trees at the beginning of each experiment, is shown in the following table:

TABLE XXII.—*Showing for each plat, elements added, and per cent of healthy trees which became diseased after the beginning of the treatments in Orchards IV–VII of Dr. W. S. Maxwell, Still Pond, Md.*

Plat and fertilizer.	1889.	1890.	1891.	1892.	Total.
SERIES IV.—*Trees set in November. 1884.*					
XLV, KP	2.6	18.4	29.0	34.2	**84.2**
Twenty-first control	0.0	12.5	27.5	47.5	**87.5**
XLVI, KP	0.0	*13.9	16.7	36.1	**66.7**
XLVII, KP	2.8	41.7	38.9	8.3	**91.7**
Twenty-second control	0.0	43.8	43.8	9.4	**97.0**
XLVIII, KP	17.2	62.1	17.2	0.0	**96.5**
SERIES V.—*Trees set in November, 1885.*					
L, KP	0.0	0.0	25.0	18.8	**43.8**
Twenty-fourth control	0.0	0.0	13.3	33.3	**46.6**
LI, KP	0.0	0.0	0.0	56.3	**56.3**
LII, KPN	0.0	6.7	13.3	80.0	**100.0**
Twenty-fifth control	0.0	0.0	6.3	50.0	**56.3**
LIII, KN	0.0	†78.6	21.4	0.0	**100.0**
SERIES VI.—*Trees set in November, 1886.*					
LIV, KPN	0.0	5.8	11.5	38.5	**55.8**
Twenty-sixth control	0.0	4.0	6.0	40.0	**50.0**
LV, KP	0.0	3.9	11.8	45.1	**60.8**
LVI, KPN	0.0	4.0	†26.0	46.0	**76.0**
Twenty-seventh control	0.0	2.8	†27.8	19.4	**50.0**
SERIES VII.—*Trees set in November, 1885.*					
LVII, CaK	0.0	37.0	48.1	11.1	**96.2**
Twenty-eighth control	12.5	33.3	33.3	20.8	**100.0**
LVIII, Ca KN	10.5	10.5	57.9	21.1	**100.0**
Twenty-ninth control	5.3	15.8	52.6	21.1	**94.8**

*Some doubt as to whether these belong in 1889 or 1890. See text.
†Near the forest.

In the following table the treated plats of each series are grouped and compared with the untreated, and the total treated in the four orchards are also compared with the total untreated, the results showing a slight difference in favor of the untreated:

TABLE XXIII.—*Showing per cent of cases on total treated and total untreated in Orchards IV–VII of Dr. W. S. Maxwell, Still Pond, Md.*

Series.	Number of healthy trees at beginning of experiments.	Per cent of cases.				
		1889.	1890.	1891.	1892.	Total.
IV (set November, 1884)	139 treated	5.0	32.4	25.9	20.9	**84.2**
	73 untreated	1.4	26.0	34.2	31.5	**93.1**
V (set November, 1885)	61 treated	0.0	*19.7	14.8	34.4	**68.9**
	33 untreated	0.0	6.0	9.1	39.4	**54.5**
VI (set November, 1886)	153 treated	0.0	4.6	16.3	43.1	**64.0**
	86 untreated	0.0	3.5	15.1	31.4	**50.0**
VII (set November, 1885)	46 treated	4.3	26.1	52.2	15.2	**97.8**
	43 untreated	9.3	25.6	41.9	20.9	**97.7**
Total treated (399)		2.3	19.0	23.6	31.6	**76.5**
Total untreated (235)		2.1	14.9	25.1	30.6	**72.7**

*All but one case on one plat near the forest.

CONCLUSIONS.

In studying these tables it is manifest that slight variations are to be neglected and that more reliance is to be put on totals than on the results of particular years. The data which seem most trustworthy and important have been set in bold-face type. As in case of Mr. Greene's orchard, and the others already described, these results show that while the treatments had a marked effect upon the growth of the trees they did not restore any languishing trees or exert any restraining influence on the progress of the disease.

Some facts, however, stand out clearly: (1) The disease was first seriously prevalent next to the forest, but was not restricted to its vicinity; (2) it did not become prevalent until the trees had been set several years, the older trees succumbing first; (3) the overgrowth into late autumn did not induce an excess of cases the following year; (4) the total absence of the strain due to the production of fruit did not hinder the development of the disease; (5) overproduction in 1891 on a part of Series VI did not cause an increase of cases that year or the following year; (6) the season of 1889 was one of comparative fredom from yellows; (7) the orchards showed various degrees of resistance, the one from Wilmington decaying most quickly; (8) some trees proved much more resistant than others, irrespective of variety or treatment; (9) the most cases appeared the sixth or seventh year from planting.

SERIES VIII.—ORCHARD OF DR. W. S. MAXWELL, STILL POND MD.* (Plate XXVIII.)

This orchard really consists of two, the four rows on the east side being one year younger. The trees are one-quarter of a mile north of those just described, in a hollow at the foot of the hill and not many feet above the river. The surface is uneven and the soil variable. The south end at the base of the high hill is a stony, gravelly, yellow earth of poor quality. The central and western portion is a deep, mellow loam, rich with wash from the hills, low and level, but not wet. The northeast portion is a rather stiff clay, which is 20 feet higher than the middle or west side and forms part of the creek bluff. The slope of this bluff is also stony or gravelly like the south part of the orchard. For surface configuration see Plate XXVIII.

The trees are largest in the bottom, where they have made a rapid growth. On the gravel they are small and have a starved appearance. On the clay they are midway in point of size.

The west ten rows were set in November, 1885. The east four rows were set in November, 1886. The distance apart approximated 18½ by 19½ feet, giving a total of 120 per acre. All came from R. G. Nicholson, Chestertown, Md., except the Early Yorks, which were procured from Randolph Peters, Wilmington, Del.

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* No. 18 of Bull. 9, 1888.

The older trees consist of the following varieties: Early York, St. John, Early Richmond, Mountain Rose, and Early Rivers, each two rows wide, counting from west to east in the order named. The younger trees are Wards Late.

The orchard is bounded on the north by a continuation of the bluff on which Orchard I of Bull. 9 formerly stood; on the east by Lingan's Creek, separated only by a steep bank and a fringe of trees and bushes; on the south by the hill already mentioned; on the west and southwest by a slope of the same hill in pasture, and on the northwest by a marsh into which the field drains, and which is only a few feet lower than the northwest corner of the orchard.

The orchard was cultivated with maize in 1886 and without a crop in 1887. It was planted to Indian corn in 1888, and that in the rich bottom grew to a height of 8 or 10 feet. That autumn strips between the rows were sowed to winter wheat. This was drilled in with superphosphate at the rate of 300 pounds to the acre, and looked well in the spring of 1889. The strips occupied by the trees and not sowed to wheat were from 5 to 10 feet wide.

The orchard bore no fruit in 1886 or 1887, and none of any consequence in 1888, *i. e.*, some trees bore a few peaches and others not any.

The first cases of yellows appeared in the older trees in the summer of 1887 (!) before they had borne any fruit. There were seven cases that year, all of them being in the trees which came from Wilmington, Del. In August, 1888, when the orchard was reëxamined, it was noted as having grown much within a year, especially the older trees. There was also a large increase of yellows, confined, however, entirely to the ten rows on the west side—the older trees. Including six doubtful trees which showed distinct symptoms in 1889 and were probably affected from the start, there were one hundred and five new cases. Twenty-one of these trees bore premature peaches and the rest were diagnosed by the diseased shoots and unfolding winter buds. The entire freedom from yellows of the east four rows, one year younger, was noteworthy. They had made only a moderate growth, relatively less than the older trees in the bottom, and were healthy except a few in the southeast corner which were badly dwarfed by root aphides.* *i. e.* only one-fourth to one-third the size of the others.

The older trees have been divided for treatment into four sections, numbered from north to south and crossing the varieties at right angles. The younger trees have been divided into two sections, each two rows wide and extending the entire length of the orchard north and south.

EXPERIMENT LIX.

Preliminary examination (*May 11, 1889*).—This plat consists of hillside and bottom land in about equal proportions, the larger and more vigorous trees being on the latter.

Originally, it contained seventy trees in a rectangle, 7 by 10, but four on the east end of the north row are included in the thirtieth control and nine are gone, eight of them affected by yellows, having been removed in 1888 and sent to Prof. T. J. Burrill for experimental purposes.* Of the remaining fifty-seven trees, twenty are diseased by yellows (cases of 1888), four are doubtful, and thirty-three are healthy.

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* The black peach aphis, *Entomologica Americana*, Vol. VI, pp. 101–103 and 201–207.

First treatment (*May 11, 1889*).—Each tree was dosed with 6½ pounds of the Goessmann-Penhallow mixture, compounded as follows:

	Pounds.
Kieserite (50 per cent $Mg\ SO_4$)	25
Muriate of potash (50 per cent K_2O)	150
Dissolved bone black (16–18 per cent soluble and available P_2O_5)	450
Total	625

This was sowed around the trees and out into the wheat for a short distance, and was immediately cultivated in.

First result (*September 5, 1889*).—There are eleven new cases, including two doubtful. Of the four which were doubtful last year three remain so, and one shows plain symptoms of yellows. None of the old cases give any indications of recovery.

Second treatment (*May 14, 1890*).—Each tree received 6½ pounds of the same mixture as last year. It was sowed thickly from the trunk outward as far as the spread of the branches, and was cultivated in immediately. Only about one-fourth of the whole surface was covered, *i. e.* the parts most drawn upon by the roots.

Second result (*October 9, 1890*).—Twenty new cases, including one doubtful. Of the two trees which became doubtful last year one is now plainly diseased and the other is still uncertain. Two of the earlier doubtfuls (suspects of 1888) now show plain symptoms and the other is still doubtful, not healthy, and yet not showing unmistakable signs of yellows, *i. e.* unfolding winter buds. Only three trees remain healthy. None of the old cases have recovered, unless it is the northwest corner tree (case of 1889), which now resembles certain doubtful trees on the thirty-first control. I can find no diseased shoots or unfolding buds, and the foliage looks moderately healthy, although it is not bright green or vigorous.

REMARK.—The treatment was abandoned, but the trees were kept under observation for another year, although of little value.

Third result (*October 7, 1891*).—There are four new cases, including one formerly doubtful. None of the old cases have recovered or improved. The corner tree now shows distinct symptoms once more, and the other trees which were doubtful are so no longer. No trees remain healthy. Six diseased trees have died and five are almost dead.

THIRTIETH CONTROL.

Preliminary examination (*May 11, 1889*).—This block is on the north end of the orchard—*i. e.*, of the older trees. The soil is partly hillside and partly bottom land, the slope being west and north. It joins LIX to the south. Originally there were fifty-four trees, but two diseased ones have been removed. Of these fifty-four trees, eighteen became diseased by yellows in 1888 (if we include one doubtful) and thirty-six are now healthy.

First result (*September 5, 1889*).—Six new cases, including one doubtful. The doubtful case of last year now shows plain symptoms.

Second result (*October 9, 1890*).—The old cases have not recovered and there are sixteen new cases. The tree which became doubtful last year remains so.

Third result (*October 7, 1891*).—Thirteen new cases, including one doubtful. The tree which has been doubtful for two seasons now shows plain symptoms and has probably been diseased since 1889. One tree remains healthy. None have died.

Experiment LX.

Preliminary examination (*May 11, 1889*).—This plat is on the south side of the orchard. Part of the trees are on the stony hill slope and part in the rich bottom. Originally there were fifty trees in a rectangle 5 by 10. Of these fifty trees, seven have been removed on account of yellows (cases of 1887), twenty-two are diseased (cases of 1888), five are doubtful, and sixteen are healthy.

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* These trees were set out in good Illinois earth, but none of them recovered.

First treatment (*May 11, 1889*).—Each tree was dosed with 6½ pounds of the same mixture as that put on LIX. It was applied in the same manner and was cultivated in immediately.

First result (*September 5, 1889*).—Two new cases. One doubtful tree is dead—cause uncertain. The other doubtful trees continue doubtful.

Second treatment (*May 14, 1890*).—The same treatment as last year—*i. e.*, 6½ pounds per tree of the Goessmann-Penhallow mixture. This was sown thickly around each tree within a radius of about five feet, except that the west six trees of the south row received none whatever. Three of these trees are healthy and three diseased. The fertilizer was cultivated in immediately.

Second result (*October 9, 1890*).—Thirteen new cases, including three of the trees which have been doubtful since 1888 and now show plain symptoms. None of the old cases have recovered. Five healthy trees remain. The south row was included in the pasture last spring, and has been browsed closely by horses and cattle.

REMARK.—The treatment was abandoned as hopeless, but the trees were retained.

Third result (*October 7, 1891*).—Two new cases, one of which is a tree which has been stunted and doubtful since 1888 and now shows plain symptoms of yellows. One healthy tree remains, and two others, on the south row in the pasture, have been killed by animals. Five of the diseased trees have died.

THIRTY-FIRST CONTROL.

Preliminary examination (*May 11, 1889*).—This plat is between LIX and LX, and almost all of it is dark bottom land, on which the trees have grown rapidly. There are sixty trees in a rectangle 6 by 10, thirty-two of which are diseased by yellows (cases of 1888), five are doubtful, and twenty-three are healthy.

First result (*September 5, 1889*).—Eleven new cases, including four doubtful. Three of the five, which have been doubtful since 1888, now show plain symptoms and are included on the map as cases of 1888. The other two are still doubtful.

Second result (*October 9, 1890*).—Nine new cases, including one doubtful; the two trees which have been doubtful since 1888 also now show plain symptoms. Most of the diseased trees are worse than last year, but a few bear fairly good foliage and show no diseased sprouts or unfolding winter buds. One or two are cases of 1888.

Third result (*October 7, 1891*).—There are four new cases, and the trees which were doubtful are so no longer, with exception of one suspect of 1888, which appears healthy. None have recovered and five of the cases of 1888 have died.

EXPERIMENT LXI.

Preliminary examination (*May 11, 1889*).—This plat joins the older orchard on the east. The soil consists of stony hillside, rich bottom land, and clay upland. The trees are one year younger and proportionately smaller than those already described. There are forty-six in a rectangle 2 by 23 and all are healthy.

First treatment (*May 11, 1889*).—Each tree was dosed with 3 pounds of the following mixture:

Kieserite	pounds	5.8
Muriate of potash	do	34.5
Dissolved bone black	do	103.5
Total		143.8

This was sown in the same manner as on the other plats—*i. e.*, thickly around the trees and not at all in the middles beyond the reach of the roots. It was cultivated in on the strips opposite LIX and LX and not on those parts opposite the two controls.

First result (*September 5, 1889*).—One case of yellows has made its appearance in the bottom opposite the thirty-first control. The rest of the trees are healthy, but have not responded to the fertilizer by a very vigorous growth.

Second treatment (*May 14, 1890*).—Each tree received the same amount of the same mixture as last year. It was sowed in a circle around the trunks out to beyond the spread of the branches and was cultivated in immediately. Not over one-fourth of the whole surface was covered, the trees not being very large.

Second result (*October 9, 1890*).—The old case has not recovered, and there are twenty-one new cases, including two doubtful. A very bad showing for so young an orchard, and one that has never borne any fruit. The Goessmann-Penhallow mixture has been put on two years in succession at the rate of 360 pounds per acre, and this year, if the whole plat had been dosed as heavily as the soil in which the roots are growing, the rate per acre would have been 1,440 pounds.

REMARK.—The treatment was abandoned, but the trees were retained for further study.

Third result (*October 7, 1891*).—Eight new cases. None of the old cases have recovered and the two doubtful trees show distinct symptoms. Sixteen trees are still healthy—*i. e.*, only about one-third. The south two trees, still healthy, have been browsed by cattle for two years and are stunted scrubs.

THIRTY-SECOND CONTROL.

Preliminary examination (*May 11, 1889*).—This plat is next east of LXI, and the soil conditions are the same. The trees are also of the same age and variety, but of the two they are rather better on LXI, all being healthy and, exclusive of a few large trees in the bottom, of nearly uniform size, while on this plat the south ten trees are badly dwarfed by root aphides. On the north end the wagon road follows the curve of the bluff to the west, and the outer row stops short of the north line. Altogether there are forty trees in two rows, all of which are free from yellows.

First result (*September 5, 1889*).—No cases of yellows have appeared, but five trees on the south end have died from the attacks of the root aphides, and two others are in a very feeble condition.

REMARK.—One of the trees dwarfed by root aphides was treated in the spring of 1889 with 2 pounds of the Goessmann-Penhallow mixture to see if it would not drive away the insects or stimulate the tree to outgrow its injuries. The mixture was sown evenly around the trunk over a diameter of about 4 feet, which more than covered the spread of the branches, so great was the dwarfing, but apparently it did no good. The tree is very feeble, and there has been no marked increase in size or vigor. The foliage is only 1 to 2 inches long and there is not much of it.

Second result (*October 9, 1890*).—Fifteen cases of yellows. Three of the trees suffering from root aphides have died, one of them being the tree which was treated.

Third result (*October 7, 1891*).—Eleven new cases of yellows. Six trees are still free from that disease, but one of them is badly dwarfed by the root aphides. There is certainly no direct connection between these two diseases. Only one of the ten badly dwarfed trees contracted yellows and that not until 1891. The aphides were actually found on the roots of these trees associated with the yellow ant, *Lasius claviger*.

GENERAL REMARKS.

1889: *May 11.*—The diseased trees begin to be distinguishable already by the lighter green of their growing foliage.

September 5.—The result in this orchard was a surprise. Many cases were expected among the younger trees, and only one case developed. There have also been fewer cases this year among the older trees than was anticipated. None of the trees bore any fruit. The field was not cultivated during the season, except to work in the fertilizers.

1890: *May 14.*—This orchard has been plowed, and Dr. Maxwell has set asparagus slips on the south one-third. The remainder has been planted to Indian corn, which is now about 2 inches high. The trees bear a few scattering peaches which are about the size of large filberts.

October 9.—The result in the younger part of the orchard was as great a suprise as last year, about 40 per cent of the trees having developed yellows. It has now been set four years, and is in about the same condition as was the older part when it had been set three years. The orchard is much worse than last year. With but few exceptions, the foliage has a miserable, stunted, reddish-yellow appearance, and the trees are almost entirely worthless and would have been removed this fall but for the experiment's sake.

The orchard matured no fruit this year. It is now quite grassy and weedy, except the clay bluff, where the trees also are not more than one-third as large as those in the bottom. At this date the treated and untreated blocks are not distinguishable by any difference in foliage, and Dr. Maxwell says the orchard has looked much as it does now the whole season through.

1891: *April 21.*—The treatments were abandoned, and no particular attention was paid to this orchard. From a distance the foliage already begins to look yellowish-green and sickly.

July 23.—This orchard is very badly diseased, and in the older part there do not seem to be a half dozen healthy trees. Even those which look green and tolerably well at a distance are found, on closer inspection, to bear premature fruit. Most of the trees are very yellow and stunted. The orchard bears its first crop this year, *i. e.*, those trees which are healthy enough to do so.

October 7.—This orchard is worse than last year. There are additional cases and no recoveries. There is no difference in the appearance of the treated and the untreated sections, nor was there earlier in the season. On most trees the foliage is very red, yellow, and scanty. As last year, the trees on the clay bluff are not more than one-third the size of those in the bottom.

1892: The orchard was removed in the winter of 1891–'92.

SUMMARY.

The cases, by years, in this orchard from the first appearance of the disease are shown in the following table:

TABLE XXIV.—*Showing number of trees planted, time of planting, and cases of peach yellows by years, in Orchard VIII, of Dr. W. S. Maxwell, Still Pond, Md.*

Year.	Cases by years.	
	230 trees, set November, 1885.	86 trees, set November, 1886.
1887	7	0
1888	105	0
1889	30	1
1890	58	36
1891	23	19
Total cases	223	56

The per cent of cases by plats, figured on the number of healthy trees at the beginning of the experiments, is shown in the following table:

TABLE XXV.—*Showing, for each plat, the per cent of healthy trees which became diseased after the commencement of the treatments with the Goessmann-Penhallow mixture, in Orchard VIII, of Dr. W. S. Maxwell, Still Pond, Md.*

Year.	Per cent of cases on treated and untreated.*					
	LIX (33 healthy trees).	Thirtieth control (36 healthy trees).	LX (16 healthy trees).	Thirty-first control (23 healthy trees).	LXI (46 healthy trees).	Thirty-second control (40 healthy trees).
1889	33.3	16.7	12.5	47.8	2.2	0.0
1890	57.6	44.4	62.5	30.4	45.7	37.5
1891	9.1	36.1	6.2	17.4	17.4	27.5
Total	**100.0**	**97.2**	**81.2**	**95.6**	**65.3**	**65.0**

*This does not include the suspects, which afterward showed plain symptoms.

CONCLUSIONS.

The following conclusions appear to be warranted:

(1) The treatments exerted no curative and no restraining influence; (2) the absence of the strain of fruit production and the youth of the orchard did not protect it; (3) the largest and most vigorous trees were among the earliest to be attacked; (4) marked differences in the soil did not prevent a finally uniform result; (5) the trees of the younger orchard resisted better than those in the older one, *i. e.*, the orchard set in November, 1885, was very seriously diseased in all parts the third season, while the trees set in November, 1886, did not succumb in numbers until the fourth season; (6) the trees dwarfed by root aphides were not specially subject to yellows; (7) there was a remarkable diminution of cases in 1889; (8) the progress of the disease in individual trees was slow, comparatively few of the trees being entirely dead at the time the orchard was dug out.

SERIES IX.—ORCHARD OF F. H. HARPER, STILL POND, MD. (Plate XXIX.)

This orchard is on what is known as the Howard farm, about two miles east of those just described, on level upland, a mile from Sassafras River. It is on the south side of the highway, west of the farm buildings, in a field containing 27½ acres. The trees were bought of Randolph Peters, Wilmington, Del., and it is not known where they were grown, or from what pits or buds they were propagated. They were set in the spring of 1881, at a distance apart of 20 by 20 feet, and the total number planted was 2,954.

Eighty-six appear to have died from accidents of culture or the original shock of transplanting. The remainder prospered and made a fine orchard, which was a source of pride to its owner.

Counting from west to east, the orchard is set to the following varieties, which appear to have been mixed in the nursery or packing house, or to have been set without judgment: Smock, with a few Crawford

Early; Susquehanna; Harkers Seedling; Mountain Rose, with a few Reeves; Beers Smock; Marys Choice and Harkers Seedling, mixed; Crawford Late, with some Harkers Seedling; Christiana; Old Mixon (free); Reeves; Crawford Early, and Variegated Free.

The early history of the orchard is only imperfectly known. It is said to have received a liberal dressing of barnyard manure when it was young, and Mr. William B. Price, the present tenant, says that when he came upon the place in 1885 there was a small heap of stable manure around the trunk of each tree, perhaps one-half wheelbarrow load. These heaps were spread, and no manures or commercial fertilizers were used thereafter until the beginning of these experiments.

Nothing is known as to the methods of cultivation in 1881, 1882, 1883, and 1884; but the probabilities are that the trees were carefully tilled in maize during the early part of each growing season for several years, this being a common practice.

There was no fruit in 1881, 1882, 1883, or 1884. The orchard bore about 200 baskets in 1885, a full crop in 1886, and good crops in 1887 and 1888, part of the fruit on the diseased trees, or all of it in a few cases, being premature. The fruit produced by this orchard has always been of good size, and of fine quality except when affected by yellows.

In 1887 the trees were very thrifty and of nearly uniform growth. They possessed good tops, smooth limbs and trunks, and were remarkably free from borers, bruises, dead limbs, or injuries of any kind. Judging from their appearance at this time their growth had been uniform and satisfactory each year from the time the orchard was planted.

Yellows first appeared in the summer of 1886 in four trees in the extreme northeast corner of the orchard. These trees bore premature, red-spotted peaches, but no starved shoots, and on one of them only one limb produced the diseased fruit. In the summer of 1887 there were 318 new cases, distributed over all parts of the orchard, but most numerous on the north side where the soil was flat and moist. In 1888 there were 301 additional cases. Both years, almost without exception, the disease developed in fine, thrifty trees free from borers or injuries of any sort. In a majority of cases, *i. e.*, more than three-fourths, the symptoms were manifest on a part of the tree at first, not involving the remainder until the second or third year.

This orchard was believed to be specially suited to experiments for the following reasons:

(1) The fine growth of the trees and their remarkable freedom from borers, root aphides or injuries of any sort.

(2) The large number of cases which appeared in 1887 and 1888; the prevalence of the disease in all the bearing orchards in the vicinity, including a younger one on the same farm and the strong probability that it would continue in this orchard.

(3) The very gradual manner in which many of the trees succumbed, *i. e.*, limb by limb, which if it continued would give the fertilizers plenty of time to act.

(4) The very uniform appearance of the soil.

(5) The privilege of experimenting upon the whole orchard for as long a time as might be necessary.

One nitrogen treatment was undertaken in 1891, unleached ashes were used on certain diseased trees; and a few other small experiments were carried along incidentally, but the bulk of the experiments were begun in the spring of 1889, with the strongly endorsed Goessmann-Penhallow mixture, the effort being to keep the disease from making any inroads on the treated blocks.

In all, twenty-four plats including about 6 acres, were selected for preventive treatment. Only the healthiest portions of the orchard were picked out, and yet the plats were not restricted to any one part of the field, as may be seen from Plate XXIX. On most of the plats all or nearly all of the trees were healthy at the beginning of the experiments, and on none of them were there, or had there been, more than seven diseased trees. The control areas, including about 8 acres, were distinctly less free from yellows than the plats selected for treatment, but they were next freest from disease. On the remainder of the orchard the ratio of cases to trees was considerably greater.

The cases of 1886 and 1887 were dug out the following winters. Those of 1888, with the exception of a few trees that were overlooked, were cut back in the fall of 1888, or early spring of 1889, to the stubs of the main limbs, and these were covered with tufts of diseased shoots in the spring of 1889. These stubs were dug out the following winter.

The orchard has been pruned from time to time by the removal of branches from the base of the main limbs and from the interior of the top, but the branches were never shortened in.

The orchard is bounded on the north by the highway, from which it is separated by a well pruned, vigorous hedge of osage orange. Beyond the highway is a level cornfield of many acres. On the east are the farm buildings and an open field used for pasture. On the south is a somewhat rolling field of poorer soil, occupied by a younger peach orchard of about the same area.* On the west, on the adjoining farm, is a wheat field which is level for some rods and then slopes into a cultivated sag 20 or 30 feet lower.

There is no artificial drainage, the excess of rainfall seeping through the earth, or, on the south side, finding its way over the surface through two depressions which are the beginnings of ravines well developed farther south. One of these is midway of the orchard east and west, the other is in the extreme southwest corner, and the bottoms of both are 10 or 15 feet lower than the rest of the orchard, but cultivated. In places on the north side the water stands on the surface in wet seasons after repeated heavy rains, but not long enough to kill grass or weeds. It is not a wet field. The elevation above the river is about 100 feet and the depth of the nearest well, a few rods to the east, is 46 feet, the depth of water in it being usually 8 or 10 feet.

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*About 18 acres of this was removed in the spring of 1892 on account of yellows

The soil is a rather stiff loam about 8 inches deep, inclined to hold moisture and quite distinct from the porous, yellow clay subsoil.* The tenant says the soil of this field tills easier than that of others on the same farm, but it is the most clayey field mentioned in these experiments. Judged by the growth of trees and weeds the soil is fertile. The principal weeds observed in this orchard have been: *Setaria glauca, S. viridis, Panicum sanguinale, Erigeron canadensis, Teucrium canadense, Plantago rugelii, Asclepias cornuti, Abutilon avicennæ, Datura stramonium, Euphorbia hypericifolia, Cenchrus tribuloides, Polygonum persicaria* (in dampest places on the north side), *Bidens bipinnata, Xanthium strumarium, Daucus carota.*

The surrounding fields bear excellent maize and wheat, the yield of wheat averaging about 30 bushels per acre and that of corn about 60 bushels. Since the failure of the peach harvests, corn, wheat, and asparagus have been the principal crops on this farm, but stock is kept.

According to report the field was once heavily timbered. On the north side of the orchard are some locust trees, in the center is a large black walnut, on the western edge is a large chestnut, and on the borders of the southwest ravine are some white oaks, black walnuts, and mulberry trees of moderate dimensions. There are no other trees on the field, but the timber of neighboring forests is like that mentioned under Series IV.

The field has been cleared and in pasture or under cultivation for at least sixty years and probably more, but no record was ever kept and it is impossible to determine what crops were taken from the land or what was put back in the way of fertilizers. Wheat and corn are now grown in this region with the use of superphosphates, and the tillage is usually thorough.

The cultivation of the orchard since 1885 has been good. It has been plowed carefully each spring to a depth of 3 to 6 inches and then cultivated shallow several times during the fore part of the season. It has been the custom to refrain from stirring the soil after July so as to avoid a growth into late autumn. No crops have been grown between the tree rows since 1885.

The Goessmann-Penhallow treatments were begun in the spring of 1889, and were continued until 1891. The formula of the mixture used on this orchard for each treatment is given below. The mixtures contained by weight:

	Per cent.
Kieserite (50 per cent $MgSO_4$)	4
Muriate of potash (50 per cent K_2O)	24
Dissolved bone black (16–18 per cent soluble and available P_2O_5)	72
Total	100

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* The color of the dry soil is between Ridgway's drab and isabella; when wet it between raw umber and bistre.

EXPERIMENT LXII.

Preliminary examination (*May 14, 1889*).—This plat is on level land in the northwest corner of the orchard. Originally there were seventy trees, but five have disappeared, some of them possibly having been removed on account of yellows which developed in 1887. Of the trees which remain, sixty-two are healthy and three are diseased. Two of the latter developed yellows in 1888, prior to August 6, and the third sometime between that date and the spring of 1889.

First treatment (*May 14, 1889*).—About 3.3 pounds of the Goessmann-Penhallow mixture was carefully sowed under the branches of each tree, covering in this way nearly the whole surface of the plat. It was harrowed in.

First result (*September 17, 1889*).—One new case and one doubtful tree. The three diseased trees have not recovered. The others are still healthy.

Second treatment (*October 29, 1889*).—Each tree was dosed with 3 pounds of the Goessmann-Penhallow mixture. This was distributed evenly from the trunks outward to beyond the spread of the branches so that nearly the whole surface was covered. It fell upon wet earth two days after a heavy rain, and was plowed down 3 to 4 inches as soon as the soil was dry enough to work, *i. e.* November 1.

Third treatment (*May 16, 1890*).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. The fertilizer was carefully sowed under the branches, about two-thirds of the whole surface of the plat being covered. It fell upon plowed ground, moist from recent heavy rains, but was not harrowed in until a few days later, when the field was dry enough to receive its first cultivation.

Second result (*October 10, 1890*).—Two new cases. The tree which became unhealthy and suspicious in 1889 is still doubtful. Of the other cases, three are worse than last year, and one was removed by mistake.

Fourth treatment (*April 27, 1891*).—Each tree received an additional 4 pounds of the Goessmann-Penhallow mixture which fell upon unplowed earth and was turned under some days later.

Third result (*October 5, 1891*).—Three new cases. The old cases are worse than last year, and the tree which has been doubtful for two seasons now shows unfolding winter buds. A majority of the trees are still healthy.

Fourth result (*October 6, 1892*).—Ten new cases. The old ones are worse than last year.

EXPERIMENT LXIII.

Preliminary examination (*May 14, 1889*).—Originally this plat contained sixty trees in a rectangle 5 by 12. It is next north of LXII, and agrees with it in character of the soil and appearance of the trees. Five trees are gone, some of them, perhaps, having been removed on account of yellows which appeared in 1887. Of the remaining trees one has developed symptoms of yellows since August 6, 1888, and the other fifty-four are healthy, but two of them were broken off and nearly destroyed by the tornado of August 21, 1888.

First treatment (*May 14, 1889*).—Each tree received about 3.3 pounds of the Goessmann-Penhallow mixture, which was applied in the same manner as on Plat LXII. May 17 each tree received 2 pounds of muriate of potash, which was distributed over the surface as far out as the branches extended.

First result (*September 17, 1889*).—Four new cases, *i. e.*, twice as many as on LXII, which did not receive the extra muriate. The old case has not recovered.

Second treatment (*October 29, 1889*).—Each tree received 3 pounds of the Goessmann-Penhallow mixture. This was sowed in the same manner as on LXII, and was plowed down November 1.

Third treatment (*May 16, 1890*).—Each tree received 4 pounds of the same mixture. The fertilizer was carefully sowed under the branches of each tree, about two-thirds of the whole surface being covered. It fell upon moist earth and was harrowed in a few days after.

Second result (*October 10, 1890*) —Six new cases, including two doubtful. The old cases have not recovered.

Fourth treatment (*April 27, 1891*).—Each tree received 4 pounds of the Goessmann-Penhallow mixture and an extra 2 pounds of muriate of potash. The fertilizers were sowed under the branches, covering in this way about three-fourths of the whole surface. By an error five trees to the north were treated, and the same number on the east end of the south row of this plat received no treatment, but this made no difference in the results.

Third result (*October 5, 1891*).—Five new cases. The old cases have not recovered, and the two trees which became suspicious in 1890 now show distinct symptoms of yellows.

Fourth result (*October 6, 1892*).—One new case. The old cases are worse than last year.

THIRTY-THIRD CONTROL.

Preliminary examination (*May 14, 1889*).—This plat is immediately south of LXII and LXIII and comparable with them, consisting of similar soil and bearing trees of the same varieties and general appearance. Originally there were 132 trees in a rectangle 11 by 12, but seventeen are gone, some probably having been removed on account of yellows which appeared in 1887. Of the trees which remain eight contracted yellows in 1888, and 107 are healthy.

First result (*September 17, 1889*).—No well-defined new cases, but one tree has become doubtful. None of the old cases have recovered and two are dead.

Second result (*October 10, 1890*).—Eight new cases, including two doubtful. The tree which was doubtful last year remains so. Two old cases have been dug out and the rest have not recovered.

Third result (*October 5, 1891*).—Seven new cases, several of which appeared to be diseased in the spring, although healthy the preceding autumn. The three doubtful trees are still doubtful. They are unhealthy and probably diseased by yellows, but do not now show distinct symptoms, *i. e.*, the unfolding of winter buds.

Fourth result (*October 6, 1892*).—Eight new cases. The three doubtfuls are now very worthless-looking trees.

EXPERIMENT LXIV.

Preliminary examination (*May 14, 1889*).—This plat is 10 rods east of LXIII, on level land. Originally there were twenty-seven trees in a rectangle 3 by 9, but two are gone. Of the remaining twenty-five, all are healthy except one, which is apparently suffering from yellows, although it did not show symptoms of disease in August, 1888. The soil is uniform and the trees are of quite even growth.

First treatment (*May 14, 1889*).—About 3.3 pounds of the Goessmann-Penhallow mixture were evenly distributed under each tree top as far out as the spread of the branches, care being taken to put none on the trunks.

First result (*September 7, 1889*).—The tree which was suspicious shows only very slight symptoms of disease, but one limb was cut out and removed by some one after the spring treatment. The other trees have made an excellent growth and are entirely healthy.

Second treatment (*October 29, 1889*).—Each tree was dosed with 3 pounds of the same mixture. This was sowed in the same manner as on all the plats, *i. e.*, evenly under each tree top as far out as the branches extended, no special care being taken to prevent the fertilizer from touching the trunk, the experience of the preceding treatment having shown such precautions to be unnecessary in case of large trees. It fell upon moist earth and was plowed down 3 to 4 inches November 1, *i. e.*, as soon as the soil was dry enough.

Third treatment (*May 16, 1890*).—Each tree received 4 pounds of the same mixture. It was distributed evenly under the branches, on moist earth, about two-thirds of the whole surface being covered. The plat was harrowed some days later, *i. e.*, as soon as the field was dry enough to cultivate.

Second result (*October 10, 1890*).—Four new cases. The suspected tree now shows distinct symptoms, *i. e.*, the spring foliage is rolled, curled and red, and winter buds are unfolding.

Fourth treatment (*April 27, 1891*).—Each tree received 4 pounds of the same mixture. This was sowed under the branches from the trunks outward, covering about two-thirds of the whole surface. It was plowed down some days later.

Third result (*October 5, 1891*).—One new case. The old cases are worse than last year.

Fourth result (*October 6, 1892*).—Four new cases, including one doubtful.

EXPERIMENT LXV.

Preliminary examination (*May 14, 1889*).—This plat joins the last on the north. The surface is flat, and the soil is of the same character—a rather heavy clay loam with a yellow clay subsoil. The trees look alike. Originally there were twenty-four in a rectangle 4 by 12, but only twenty-one remain. All of these are healthy and of uniform appearance, except one, which was healthy August 6, 1888, but now shows symptoms of yellows, and one which was broken off by the tornado of August 21. The three missing trees may have been removed on account of yellows, which developed in 1887.

First treatment (*May 14, 1889*).—This treatment was, in all respects, a duplicate of LXIV. May 17 each tree received an extra 2 pounds of muriate of potash, which was distributed in the same manner as the Goessmann-Penhallow mixture.

First result (*September 17, 1889*).—No new case, but the tree which was suspicious is now certainly affected by yellows.

Second treatment (*October 29, 1889*).—A duplicate of LXIV.

Third treatment (*May 16, 1890*).—A duplicate of LXIV.

Second result (*October 10, 1890*).—No new cases. The diseased tree has been dug out.

Fourth treatment (*April 27, 1891*).—A duplicate of LXIV, except that each tree received an additional 2 pounds of muriate of potash.

Third result (*October 5, 1891*).—Two new cases.

Fourth result (*October 6, 1892*).—Two new cases, including one doubtful.

THIRTY-FOURTH CONTROL.

Preliminary examination (*May 14, 1889*).—This plat lies between LXII, LXIII, and the two last described. It is a level area, comparable with the treated plats on either side.

Originally there were ninety trees in a rectangle 6 by 15, but five have disappeared, and some of them may have been removed on account of yellows, which developed in 1887. Of the remaining trees, seventy-three are healthy and twelve contracted yellows in 1888.

First result (*September 17, 1889*).—No new cases. The old cases have not recovered and two are dead.

Second result (*October 10, 1890*).—Seven new cases. All but one of the old cases have been dug out and removed.

Third result (*October 5, 1891*).—Two new cases. The old cases have not recovered.

Fourth result (*October 6, 1892*).—Four new cases, including one doubtful.

EXPERIMENT LXVI.

Preliminary examination (*May 14, 1889*).—This plat is a few rods southeast of LXIV. The surface is level and the soil is a clay loam with a subsoil of yellow clay. There are thirty-six trees in a rectangle 4 by 9. All are healthy and of uniform growth.

First treatment (May 14, 1889).—Each tree received about 3.3 pounds of the Goessmann-Penhallow mixture, which was evenly distributed under the branches, covering nearly the whole surface, as on the other plats.

First result (September 17, 1889).—One case has appeared. One tree has disappeared, having possibly contracted yellows in the summer and been dug out by mistake. All of the others are thrifty.

Second treatment (October 29, 1889).—Each tree was given 3 pounds of the Goessmann-Penhallow mixture. This was distributed evenly under each tree top outward to beyond the spread of the branches, so that nearly the whole surface was covered. It fell upon wet earth and was plowed down 3 to 4 inches on November 1.

Third treatment (May 16, 1890).—Each tree received 4 pounds of the Geessmann-Penhallow mixture, already described. This was distributed evenly under the branches, from the trunk outward, covering about two-thirds of the surface of the plat. As in all of the sowings of this date, the portions remotest from the trees did not receive any fertilizer. The mixture fell upon wet earth, which was cultivated as soon as it had dried out sufficiently.

Second result (October 11, 1890).—Three new cases. The old case has not recovered.

Fourth treatment (April 27, 1891).—Each tree was given 4 pounds of the Goessmann-Penhallow mixture. It was sowed under the branches from the trunks outward, covering about three fourths of the whole surface, and was plowed down after some days.

Third result (October 3, 1891).—No new cases and a majority of the trees still healthy.

Fourth result (October 6, 1892).—Three new cases.

EXPERIMENT LXVII.

Preliminary examination (May 14, 1889).—This plat is of the same size as the preceding, and joins it on the north. All of the thirty-six trees are healthy and have made a uniform growth except one, which was broken off by the tornado of August 21, 1888. The two plats are comparable also as regards soil and drainage.

First treatment (May 14, 1889).—A duplicate of LXVI. *May 17:* Each tree received an extra 2 pounds of muriate of potash, distributed in the same manner as the Goessmann-Penhallow mixture.

First result (September 17, 1889).—No cases have appeared. The tree which was nearly ruined by the tornado did not develop yellows as the result of its injuries.*

Second treatment (October 29, 1889).—A duplicate of LXVI.

Third treatment (May 16, 1890).—A duplicate of LXVI.

Second result (October 11, 1890).—One case, the first.

Fourth treatment (April 27, 1891).—A duplicate of LXVI, except that each tree received an additional 2 pounds of muriate of potash.

Third result (October 3, 1891).—Seven new cases, including one doubtful. The old case has not recovered. During the last 3 years each one of these trees has received a total of kieserite 0.57 pounds; muriate of potash 7.43 pounds, and best dissolved bone-black 10.30 pounds, well worked into the soil by several plowings and harrowings

Fourth result (October 6, 1892).—Six new cases. The suspect of last year now also shows plain symptoms.

THIRTY-EIGHTH CONTROL.

Preliminary examination (May 14, 1889).—This plat is southeast of LXVI. The soil is of uniform character and quite level, only inclining on the south end very gently toward the south. Originally it contained sixty trees in a rectangle 6 by 10, but six have disappeared, some of them having probably been removed on account of yellows which appeared in 1887. Of the remaining trees, four are cases of 1888, and fifty are healthy.

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*During the last five years I have had an excellent opportunity to observe the effects of injuries by wind, man, and animals, and although I have seen thousands of cases of yellows I have never seen anything to indicate that gnawed, bruised, or broken trees are specially subject.

First result (September 17, 1889).—No new cases. The old ones have not recovered.

Second result (October 11, 1890).—Four new cases, including one doubtful. Each of the old cases has been dug out, also by mistake one healthy tree.

Third result (October 3, 1891).—Including one doubtful, there are two new cases. The doubtful of last year shows distinct symptoms.

Fourth result (October 6, 1892).—Two new cases, including one doubtful. The one which was doubtful in 1891 now shows plain symptoms.

THIRTY-NINTH CONTROL.

Preliminary examination (May 14, 1889).—This plat joins LXVI and LXVII on the east, which it resembles in character of the soil and appearance of the trees. Originally there were 60 trees but four have been crowded out by the large black walnut, and one may have been removed on account of yellows. Of the remaining trees eight are cases of 1888 and forty-seven are healthy

First result (September 17, 1889).—No new cases. The diseased trees have not recovered.

Second result (October 11, 1890).—Two new cases. The diseased trees have been dug out.

Third result (October 3, 1891).—Six new cases.

Fourth result (October 6, 1892).—Seven new cases.

EXPERIMENT LXVIII.

Preliminary examination (May 15, 1889).—This plat is about 7 rods east of LXVII, separated from it by the north part of the thirty-ninth control. It contains twenty trees in a rectangle 2 by 10. All are healthy and of uniform size. The soil is a flat, rather moist, clay loam, with a yellow clay subsoil.

First treatment (May 15, 1889).—About 3½ pounds of the Goessmann-Penhallow mixture were evenly distributed under the branches of each tree, so that almost the entire surface was covered. It was harrowed in some days later.

First result (September 17, 1889).—No cases. All of the trees are healthy and thrifty.

Second treatment (October 28, 1889).—Each tree was given 3 pounds of the Goessmann-Penhallow mixture. This was distributed evenly under the branches, as on the other plats, and was plowed down 3 to 4 inches on November 1.

Third treatment (May 16, 1890).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. This was put on and harrowed under in the same manner as on the other plats, *i. e.*, about two-thirds of the whole surface was covered, the parts most remote from the trees not receiving any.

Second result (October 11, 1890).—Three cases have appeared.

Fourth treatment (April 27, 1891).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. It was sown upon dry earth and plowed down a few days later. Only about three-fourths of the whole plat was covered, *i. e.*, the parts nearest to the trunks and most drawn upon by the roots.

Third result (October 3, 1891).—Five new cases. The old ones are worse than last year.

Remark.—This plat had three treatments before it developed any cases. Since then two-fifths of the trees have become affected each one of which received a total of 14½ pounds of the fertilizer.

Fourth result (October 6, 1892).—Four new cases.

EXPERIMENT LXIX.

Preliminary examination (May 15, 1889).—This plat joins the last on the north and is like it in character of the soil and appearance of the trees. There are 20 trees in a rectangle 2 by 10, all of which are healthy and of uniform size and excellent appearance.

First treatment (May 15, 1889).—A duplicate of LXVIII, except that on the same day each tree received an extra 2 pounds of muriate of potash, sowed in the same manner.

First result (September 17, 1889).—Two cases.

Second treatment (October 28, 1889).—A duplicate of LXVIII.

Third treatment (May 16, 1890).—A duplicate of LXVIII.

Second result (October 11, 1890).—Four new cases, and the old cases have not recovered.

Fourth treatment (April 27, 1891).—A duplicate of LXVIII except that each tree received an additional 2 pounds of muriate of potash.

Third result (October 3, 1891).—Six new cases and the old ones are worse than last year. Three-fifths of the trees are now affected against two-fifths on the adjoining plat which did not receive the extra muriate of potash. Each one of these trees has received 18½ pounds of fertilizer, *i. e.*, kieserite 0.58 pounds; muriate of potash 7½ pounds; best dissolved bone black 10½ pounds.

Fourth result (October 6, 1892).—Three new cases.

FORTY-SECOND CONTROL.

Preliminary examination (May 15, 1889).—This plat is east, northeast, and southeast of the last two plats. Originally it contained 77 trees in a rectangle 7 by 11, but five trees have been removed, probably on account of yellows. The soil is the same and the trees are of uniform growth and comparable in this respect with the treated blocks to either side, although for the most part of a different variety. Of the trees which remain, 10 are cases of 1888 and 62 are healthy.

First result (September 17, 1889).—Three new cases. Two old cases have been dug out. All the others are still diseased except possibly one which shows no symptoms (Excision experiment, No. 3).

Second result (October 11, 1890).—Three new cases. Of the old cases, five have been dug out and the rest are still diseased, including the one which seemed healthy last fall.

Third result (October 3, 1891).—Four new cases, and one doubtful.

Fourth result (October 6, 1892).—Four new cases. The doubtful of last year now looks healthy.

EXPERIMENT LXX.

Preliminary examination (May 15, 1889).—This is a small plat in the east part of the orchard. Originally there were sixteen trees, but one has disappeared, having probably been removed on account of yellows. All are healthy except one tree which showed no symptoms in August, 1888, but which is now apparently diseased by yellows.

First treatment (May 15, 1889).—About 2½ pounds of the Goessmann-Penhallow mixture were evenly distributed under the branches of each tree in the same manner as on the other plats, and with the same after treatment.

First result (September 17, 1889).—No cases have developed. The suspicious tree shows only slight symptoms suggestive of yellows, but two big limbs which may have been badly diseased were cut out by some one in the spring after my departure.

Second treatment (October 29, 1889).—Each tree was dosed with 3 pounds of the Goessmann-Penhallow mixture. This was distributed on wet earth in the way already described, and was plowed down 3 to 4 inches November 1.

Third treatment (May 16, 1890).—Each tree received 4 pounds of the Goessmann-

Penhallow mixture. This was sowed evenly under the branches from the trunks outward, covering about two-thirds of the whole surface of the plat. It was harrowed in some days later when the soil was dry enough to cultivate.

Second result (October 11, 1890).—One new case. The suspected tree bears an abundance of good leaves now yellowing to fall. It is a fine tree and shows no symptoms of disease, not even in the foliage. It may have been cured, or my suspicions may have been unfounded, although on the latter supposition it is difficult to explain why the large limbs were removed in such an unusual manner.

Fourth treatment (April 27, 1891).—Each tree was given 4 pounds of the Goessmann-Penhallow mixture. It fell upon dry earth and was plowed down a few days later. About three-fourths of the whole surface was covered, *i. e.*, the parts most drawn upon by the roots.

Third result (October 2, 1891).—Seven new cases, including two doubtful. The tree which has rested under suspicion since the spring of 1889 now shows plain symptoms of yellows on two of its three main limbs.

Fourth result (October 6, 1892).—The two suspects of last year show plain symptoms, and there are two new cases. Four healthy trees.

EXPERIMENT LXXI.

Preliminary examination (May 15, 1889).—This plat joins the last one on the north. In appearance of soil and growth of trees the two are identical. There are fifteen trees, all healthy and of uniform size.

First treatment (May 15, 1889).—A duplicate of LXX, except that each tree received an extra 2 pounds of muriate of potash put on the same day and in the same manner.

First result (September 17, 1889).—No cases. All of the trees are healthy and vigorous.

Second treatment (October 29, 1889).—A duplicate of LXX.

Third treatment (May 16, 1890).—A duplicate of LXX.

Second result (October 11, 1890).—Two cases, the first on this plat.

Fourth treatment (April 27, 1891).—A duplicate of LXX, except that each tree received an extra 2 pounds of muriate of potash put on the same day and in the same manner.

Third result (October 2, 1891).—The old cases have not recovered, and there are eight new ones. The treatment began one year in advance of any cases, but now two-thirds of the trees are diseased, *i. e.*, more than on the companion plat which did not receive the extra muriate of potash.

Fourth result (October 6, 1892).—Two new cases. Three healthy trees.

EXPERIMENT LXXII.

Preliminary examination (May 15, 1889).—This small plat is on the east side of the orchard southeast of LXX. Originally there were twenty-one trees in a rectangle 3 by 7, but two have been removed on account of yellows. Both of these developed symptoms in 1888, one prior to August 6 and the other in autumn. The nineteen which remain are healthy trees of vigorous growth.

First treatment (May 15, 1889).—About 2½ pounds of the Goessmann-Penhallow mixture were evenly distributed under each tree-top, from near the trunk outward as far as the spread of the branches. It fell upon wet earth and was harrowed in some days later.

First result.—No cases. All of the trees look remarkably well.

Second treatment (October 29, 1889).—Each tree was given 3 pounds of the Goessmann-Penhallow mixture. This was sown on wet earth and plowed down as soon as the soil was dry enough, *i. e.* November 1. The mixture was sown as far out as the spread of the branches, so that nearly the whole surface of the plat was covered.

Third treatment (May 16, 1890).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. This was distributed evenly from the trunks outward, so that about two-thirds of the whole surface was covered—*i. e.*, the parts most remote from the trees received none of the fertilizer. It was sown after rains and harrowed in some days later when the soil of the whole orchard was dry enough to cultivate.

Second result (October 11, 1890).—Four new cases.

Fourth treatment (April 27, 1891).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. It was sown upon dry earth and plowed down some days later, about three-fourths of the whole surface being covered—*i. e.*, the parts most drawn upon by the roots.

Third result (October 2, 1891).—The old cases have not recovered and there are eight new ones. The ratio of cases is about the same as on LXX, although the trees are not the same variety.

Fourth result (October 6, 1892).—No new cases. The old ones are worse than last year and badly diseased.

EXPERIMENT LXXIII.

Preliminary examination (May 15, 1889).—This plat is east of LXXI, joining LXXII on the north, with which it agrees in character of soil and appearance of trees.

Originally there were fourteen trees in a rectangle 2 by 7, but two have been removed. One of these probably contracted the yellows in 1887 and the other was a case of the late autumn of 1888. The twelve trees which remain are healthy and thrifty.

First treatment (May 15, 1889).—A duplicate of LXXII, except that each tree was dosed with an extra 2 pounds of muriate of potash. This was put on the same day and in the same manner.

First result (September 17, 1889).—One new case. All of the other trees have made a vigorous growth and are entirely free from symptoms of yellows, but the bark of the trunks and main limbs which heretofore has been very smooth and free from blemishes is attacked by *Scolytus rugulosus.* In some trees there are as many as two hundred perforations, and the trunk and main limbs are curiously studded with gum exudations. Until this summer the entire orchard has been very free from this insect; in fact, it was not observed in any of the trees. Now the whole northeast corner is infested, while other parts are yet free. The beetles are still feeding in the bark, and they have shown no preference for diseased trees. All of the healthy trees in this corner of the orchard have been attacked.*

Second treatment (October 29, 1889).—A duplicate of LXXII.

Third treatment (May 16, 1890).—A duplicate of LXXII.

Second result (October 11, 1890).—The old case has not recovered and one new case has appeared.

Fourth treatment (April 27, 1891).—A duplicate of LXXII, except that each tree received an extra 2 pounds of muriate of potash.

Third result (October 2, 1891).—Five new cases. The old ones are worse than last year.

Fourth result (October 6, 1892).—One new case.

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*The remnants of an old orchard on another part of the farm were pulled out in March, 1889, and drawn to the house for firewood, a very large pile being made in the wood yard adjoining this side of the orchard, and there seemed to be no other explanation for the sudden irruption of these beetles than that they were in the decaying trees and migrated from the wood pile to the orchard. No larvæ were found. In the summer of 1892 the same set of conditions was observed in two other orchards, one at Youngstown, N. Y., and the other at Still Pond, Md. In both, peach brush from diseased trees had been cut in the spring and piled near an orchard, and in both the only attacked trees were in the vicinity of these piles, and those most seriously attacked were closest to them.

EXPERIMENT LXXIV.

Preliminary examination (*May 15, 1889*).—This level plat joins LXXII on the east. It contains only six trees, four of one variety and two of another. All are large, healthy, and handsome.

First treatment (*May 15, 1889*).—About 4½ pounds of the Goessmann-Penhallow mixture were evenly distributed under the tree tops as far out as the spread of the branches, so that nearly the whole surface was covered. The same day, in the same manner, each tree was given an extra 4 pounds of muriate of potash. These fertilizers fell upon wet earth and the sowing was followed by rains. They were harrowed in some days later.

First result (*September 17, 1889*).—No cases. All very vigorous but badly infested by *Scolytus rugulosus*, which made its appearance this summer for the first time. The trunks and bases of the main limbs are riddled as if by fine shot but less smoothly.

Second treatment (*October 29, 1889*).—Each tree was dosed with 6 pounds of the Goessmann-Penhallow mixture. It was distributed evenly around the trunks outward to beyond the spread of the branches. It fell upon wet earth and was plowed down November 1.

Third treatment (*May 16, 1890*).—Each tree received 6 pounds of the Goessmann-Penhallow mixture. This was put on and harrowed under in the same manner as on the other plats.

Second result (*October 11, 1890*).—No cases.

Fourth treatment (*April 27, 1891*).—Each tree received 6 pounds of the Goessmann-Penhallow mixture, which was put on and plowed under in the same manner as on the other plats.

Third result (*October 2, 1891*).—No cases.

REMARK.—On account of the small size of this plat no stress should be put on the fact that no cases appeared. There are only a few treated plats on which six contiguous healthy trees might not be found, and the same is true of the controls. The evidence is very good, however, that *Scolytus rugulosus* does not cause this disease.

Fourth result (*October 6, 1892*).—One case. This tree has received: Kieserite, 0.9 pounds; muriate of potash, 9.4 pounds; dissolved bone black, 16.2 pounds.

FORTY-THIRD AND FORTY-FOURTH CONTROLS.

Preliminary examination (*May 15, 1889.*)—These comparison blocks consist of three trees to the north and three to the south of Plat LXXIV. The surface is level, the soil is the same, and the trees are of the same size and thrift.

First result (*September 17, 1889*).—No cases. All are thrifty. All have been attacked by *Scolytus rugulosus*, but are not worse than those that have been treated.

Second result (*October 11, 1890*).—No cases.

Third result (*October 2, 1891*).—No cases.

Fourth result (*October 6, 1892*).—No cases.

EXPERIMENT LXXV.

Preliminary examination (*May 15, 1889*).—This plat is about 20 rods south of the highway and somewhat further from the east side of the orchard. The soil is level, clay loam, with a yellow clay subsoil. There are twenty-five trees, in a square. All are healthy and have made a uniform and satisfactory growth. Two varieties are represented.

First treatment (*May 15, 1889*).—About 3½ pounds of the Goessmann-Penhallow mixture were distributed under each tree in the manner already described, *i. e.*, it was sowed evenly around each tree outward to beyond the spread of the branches so that nearly or quite the entire surface of the plat was covered, care being taken to let none touch the base of the trunk. It was cultivated in some days later.

First result (September 17, 1889).—One case. The trees have made a vigorous growth.

Second treatment (October 28, 1889).—Each tree was given 3 pounds of the Goessmann-Penhallow mixture. This covered nearly the whole surface; fell upon wet earth; and was plowed down 3 to 4 inches on November 1.

Third treatment (May 16, 1890).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. This was put on and harrowed under in the same manner as on the other plats, *i. e.*, that two-thirds of the earth's surface being covered which was most fully occupied by the roots.

Second result (October 11, 1890).—Five new cases, including one doubtful. The old case has not recovered.

Fourth treatment (April 27, 1891).—Each tree was dosed with 4 pounds of the Goessmann-Penhallow mixture. That three-fourths of the plat nearest the trees received the whole of the mixture. It fell upon dry earth and was turned under a few days later, when the whole orchard was plowed.

Third result (October 3, 1891).—Two new cases. The doubtful tree now shows distinct symptoms, and the old cases are worse than last year.

Fourth result (October 6, 1892).—One new case. Nine cases since the treatment began.

EXPERIMENT LXXVI.

Preliminary examination (May 15, 1889).—This plat joins LXXV on the north. The surface is level and the soil is the same. The trees are also like those on LXXV. There are twenty-five in a square, and all but two are healthy. These two were healthy August 6, 1888, but now show slight symptoms suggestive of yellows.

First treatment (May 15, 1889).—Duplicate of LXXV. May 16, each tree was dosed in the same manner with an extra 2 pounds of muriate of potash.

First result (September 17, 1889).—One new case. One of the suspicious trees is almost certainly diseased; the other appears to be entirely healthy.

Second treatment (October 28, 1889).—A duplicate of LXXV.

Third treatment (May 16, 1890).—A duplicate of LXXV.

Second result (October 11, 1890).—Three new cases, including one doubtful. The old case has not recovered. The two trees, suspicious since the spring of 1889, were dug out without my knowledge. Probably they showed distinct symptoms of yellows and were mistaken for trees not under treatment, the owner's order being to remove all cases except on the treated plats.

Fourth treatment (April 27, 1891).—A duplicate of LXXV, except that each tree received an extra 2 pounds of muriate of potash.

Third result (October 3, 1891).—Three new cases. The old cases are worse than last year, and the tree which was doubtful now shows plain symptoms.

Fourth result (October 6, 1892).—Three new cases. Ten cases since treatment began, *i. e.*, more than on the plat which did not receive the extra muriate of potash.

FORTY-FIRST CONTROL.

Preliminary examination (May 15, 1889).—This plat joins the last two on the west and begins a few rods south of LXVIII. The surface is nearly level. The soil is clay loam and the trees are like those on the treated plats, *i. e.*, fine, thrifty specimens.

Originally there were sixty trees in a rectangle 6 by 10, but ten have disappeared, most having probably been removed on account of yellows, which appeared in 1887. Of the remaining trees four are cases of 1888 and forty-six are healthy.

First result (September 17, 1889).—No new cases. The diseased trees have not recovered.

Second result (October 11, 1890).—One new case. One of the old cases has been dug out, also one of the healthy trees. Possibly the latter showed symptoms of yellows during the summer and was removed by mistake. Two of the old cases received heavy doses of wood ashes (see Experiments LXXXVII and LXXXVIII).

Third result (October 3, 1891).—Six new cases.

Fourth result (October 6, 1892).—Two new cases.

FORTIETH CONTROL.

Preliminary examination (May 15, 1889).—This large plat is south of the forty-first control and of Plat LXXV, extending to the south line of the orchard. The soil is very nearly level, falling away slightly on the west side. The trees are of quite uniform size and vigor. Originally there were 156, but fourteen have been removed, a part probably on account of yellows, which appeared in 1887. Of the remainder nineteen are cases of 1888 and 123 are healthy. One tree which was marked diseased in 1888 is now healthy—probably an error of diagnosis.

First result (September 17, 1889).—No new cases.

Second result (October 11, 1890).—Fourteen new cases, including one doubtful.

Third result (October 3, 1891).—Thirteen new cases, including one doubtful. The suspicious case of last year now shows plain symptoms.

Fourth result (October 6, 1892).—Twelve new cases. The doubtful case of last year is still doubtful.

EXPERIMENT LXXVII.

Preliminary examination (May 15, 1889).—This plat is in the middle south part of the orchard, and the soil is level except the east one-third, which slopes into the incipient ravine 10 or 15 feet lower. Originally there were thirty-six trees in a rectangle 3 by 12, but one has disappeared. All are healthy, but the trees on the east slope are small, the soil being poor and unlike that of the greater part of the orchard—*i. e.*, the richer part has washed into the bottom.

First treatment (May 15, 1889).—About 3½ pounds of the Goessmann-Penhallow mixture were evenly distributed under each tree in the manner already described.

First result (September 17, 1889).—No cases. All of the trees are thrifty.

Second treatment (October 29, 1889).—Each tree was given 3 pounds of the Goessmann-Penhallow mixture. This was sowed evenly from the trunk outward to a little beyond the spread of the branches, covering practically the whole surface. The fertilizer was plowed down 3 to 4 inches November 1.

Third treatment (May 16, 1890).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. This was distributed evenly over about two-thirds of the whole surface—*i. e.*, on the parts nearest to the trees. It was sowed after rains, and was harrowed in as soon as the soil was fit to cultivate.

Second result (October 11, 1890).—There are eight cases, including one doubtful.

Fourth treatment (April 27, 1891).—Each tree was given 4 pounds of the Goessmann-Penhallow mixture. This fell upon dry earth and was plowed down May 4. Some part of that put on the slope was probably washed into the bottom and lost by the rain of May 3.

Third result (October 5, 1891).—Including one doubtful, there are three new cases. None of the old cases have recovered, and the one which was doubtful is now certainly diseased. The infertile slope has been freest from cases.

Fourth result (October 6, 1892).—Two cases, including one doubtful. The suspect of last year shows plain symptoms.

EXPERIMENT LXXVIII.

Preliminary examination (May 15, 1889).—This plat joins the last one on the north. The surface is level and the trees have made a good growth. As on LXXVII, three varieties are included.

There are forty-eight trees in a rectangle 4 by 12. All are healthy. The extreme east end slopes toward the bottom, but only a few trees are involved.

First treatment (*May 15, 1889*).—A duplicate of LXXVII. *May 16.*—Each tree was dosed in the same manner with an extra 2 pounds of muriate of potash.

First result (*September 17, 1889*).—No cases. All healthy.

Second treatment (*October 29, 1889*).—A duplicate of LXXVII.

Third treatment (*May 16, 1890*).—A duplicate of LXXVII.

Second result (*October 11, 1890*).—Seven cases, including one doubtful.

Fourth treatment (*April 27, 1891*).—A duplicate of LXXVII, except that each tree received an extra 2 pounds of muriate of potash.

Third result (*October 5, 1891*).—One tree has become suspicious, but there are no other cases. The old ones are worse than last year, and the one which was doubtful is plainly diseased.

Fourth result (*October 6, 1892*).—No new cases.

THIRTY-SEVENTH CONTROL.

Preliminary examination (*May 15, 1889*).—This large plat is south and southwest of those last mentioned, extending from Plat LXXVII and the forty-sixth control to the south boundary of the orchard. The trees have the same general appearance as those on the plats selected for treatment. Originally there were one hundred and twenty-seven trees. The plat now contains one hundred and ten healthy trees; three cases of 1888, and fourteen vacant places, from some of which diseased trees may have been removed in 1887. The soil is level, except on the extreme east end bordering the sag.

First result (*September 17, 1889*).—No unquestionable cases, but one tree is probably diseased.

Second result (*October 11, 1890*).—The suspected tree has the yellows, and there are seven new cases, including one doubtful. One healthy and two diseased trees have been dug out.

Third result (*October 5, 1891*).—Nine new cases, including two doubtful. The suspect of last year shows distinct symptoms.

Fourth result (*October 6, 1892*).—Eight new cases. One of last year's suspects now shows plain symptoms and the other is still doubtful.

EXPERIMENT LXXIX.

Preliminary examination (*May 15, 1889*).—This plat is in the extreme southwest corner of the orchard, and the west one-third slopes into the beginning of the southwest ravine. There are twenty-four trees in a rectangle 2 by 12. All are healthy.

First treatment (*May 15, 1889*).—About 2½ pounds of the Goessmann-Penhallow mixture were evenly distributed under the branches of each tree, so that nearly the whole surface was covered. It was cultivated in after some days.

First result (*September 17, 1889*).—No cases. All are healthy.

Second treatment (*November 1, 1889*).—Each tree was given 3 pounds of the Goessmann-Penhallow mixture. This was sowed in the same manner as on the other plats and at once plowed down 3 to 4 inches.

Third treatment (*May 16, 1890*).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. This was put on and harrowed under in the same manner as on the other plats.

Second result (*October 10, 1890*).—No cases. All are healthy.

Fourth treatment (*April 27, 1891*).—Each tree was dosed with 4 pounds of the Goessmann-Penhallow mixture. This fell on dry earth, which was plowed after a few days. The rain of May 3 probably washed away part of the fertilizer put upon the west slope.

Third result (*October 5, 1891*).—No cases. A good result, if it were not contradicted by the duplicate.

Fourth result (*October 6, 1892*).—One suspect.

EXPERIMENT LXXX.

Preliminary examination (May 15, 1889).—This joins the preceding plat on the north and is essentially like it. The surface is level except the west third, which slopes into the bottom.

Originally there were twenty-four trees in a rectangle 2 by 12, but one has disappeared. All that remain are healthy.

First treatment (May 15, 1889).—A duplicate of LXXIX. *May 16.*—Each tree also received an extra 2 pounds of muriate of potash put on in the same way.

First result (September 17, 1889) —No cases. All are healthy.

Second treatment (November 1, 1889).—A duplicate of LXXIX.

Third treatment (May 16, 1890).—A duplicate of LXXIX.

Second result (October 10, 1890).—Four cases, the first on this plat. One of the diseased trees is now in blossom.

Fourth treatment (April 27, 1891).—A duplicate of LXXIX, except that each tree received an extra 2 pounds of muriate of potash. On the west third some portion of the fertilizers was probably washed away by the rain of May 3.

Third result (October 5, 1891).—Including one doubtful there are three new cases, all on the east end. The old cases are worse than last year.

Fourth result (October 6, 1892).—Two new cases. The suspect is still doubtful.

FORTY-FIFTH CONTROL.

Preliminary examination (May 15, 1889).—A triangular plat south of LXXIX may be used for comparison. It contains twenty-eight healthy trees and five vacant places.

First result (September 17, 1889).—No cases.

Second result (October 10, 1890).—Three cases, including two doubtful trees.

Third result (October 5, 1891).—The two trees which were doubtful now show plain symptoms, and there are three new cases.

Fourth result (October 6, 1892).—Three new cases.

EXPERIMENT LXXXI.

Preliminary examination (May 17, 1891).—This experiment is limited to a single tree which stands on a level clay loam in the third row north of Plat LXXX. The tree first showed symptoms of yellows in 1888, and previous to that year it had made a satisfactory growth. At the time the treatment began it was quite badly diseased, but was not better or worse than other diseased trees in the same orchard. The top was not pruned back.

First treatment (May 17, 1889).—Six pounds of muriate of potash were sown evenly from the trunk outward to beyond the spread of the branches. It fell upon plowed earth and was harrowed when the whole orchard was cultivated.

First result (September 17, 1889).—The tree shows no improvement. It bears diseased shoots and dwarfed reddish and yellowish foliage on all parts, and is not better than the next tree north, which received no treatment and is also a case of 1888.

Second treatment (November 1, 1889).—The tree was given 20 pounds of the Goessmann-Penhallow mixture, distributed in the same manner as the muriate of potash. It fell upon a level surface bearing grass and weeds, but was not plowed down until spring.

Second result (October 10, 1890).—Worse than last year. Many dead branches. Winter buds are unfolding, and what spring foliage remains is red and yellow, dwarfed, rolled inward and curled outward from base to tip. This tree is as bad as the untreated one next north, and both are hopeless cases.

REMARK.—The treatment was abandoned.

Third result (October 5, 1891).—Almost dead. Several main limbs are entirely dead.

The foliage is scanty, dwarfed, rolled, red and yellowish. The short, diseased growths give the branches a very twiggy aspect.

Fourth result (*October 6, 1892*).—Dead.

EXPERIMENT LXXXII.

Preliminary examination (*May 14, 1889*).—This plat is toward the west side of the orchard and about midway north and south. The surface is level and the soil a clay loam, with a yellow clay subsoil. Originally there were twenty-four trees in a rectangle 2 by 12, but one has disappeared. The twenty-three which remain are healthy and of quite uniform appearance.

First treatment (*May 14, 1889*).—About 3½ pounds of the Goessmann-Penhallow mixture were evenly distributed under the branches of each tree in the manner already described. It fell upon wet earth and was harrowed in some days later.

First result (*September 17, 1889*).—No cases. All are healthy.

Second treatment (*October 28, 1889*).—Each tree was given 3 pounds of the Goessmann-Penhallow mixture. This was distributed under the branches, covering nearly the whole surface. It was plowed down to 3 to 4 inches November 1.

Third treatment (*May 16, 1890*).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. This was distributed evenly from the trunks outward, about two-thirds of the whole surface of the plat being covered. It fell upon moist, plowed earth, which was cultivated as soon as it had dried out sufficiently.

Second result (*October 10, 1890*).—One case. The tree is now in blossom.

Fourth treatment (*April 27, 1891*).—Each tree received 4 pounds of the Goessmann-Penhallow mixture. About three-fourths of the whole surface was covered—*i. e.*, the parts most drawn upon by the roots. The fertilizer fell upon dry, unplowed earth and was turned under a few days later.

Third result (*October 5, 1891*).—The old case continues diseased, but no additional ones have appeared. The results on this plat might perhaps be considered good were they not contradicted by those on the comparison plat.

Fourth result (*October 6, 1892*).—No new cases.

EXPERIMENT LXXXIII.

Preliminary examination (*May 14, 1889*).—This plat joins the last upon the north. The surface is level and the soil and appearance of the trees are the same. There are thirty-six trees in a rectangle 3 by 12. All are healthy.

First treatment (*May 14, 1889*).—A duplicate of LXXXII. *May 17*.—Each tree was also given an extra 2 pounds of muriate of potash.

First result (*September 17, 1889*).—No cases. All the trees are healthy.

Second treatment (*October 28, 1889*).—A duplicate of LXXXII.

Third treatment (*May 16, 1890*).—A duplicate of LXXXII.

Second result (*October 10, 1890*).—Five cases. Four of these trees bear a few fully-expanded blossoms associated with the unfolding winter buds.

Fourth treatment (*April 27, 1889*).—A duplicate of LXXXII, except that each tree received an extra 2 pounds of muriate of potash.

Third result (*October 5, 1891*).—Including one doubtful, there are three new cases. The old cases are worse than last year.

Fourth result (*October 6, 1892*).—No new cases. The suspect of last year shows plain symptoms.

THIRTY-FIFTH CONTROL.

Preliminary examination (*May 14, 1889*).—This plat joins LXXXIII on the north, extending nearly to LXIV, with either of which it is comparable. It contains sixty-three healthy trees, three cases of 1888, and six vacant places, some of which may represent cases of 1887.

First result (*September 17, 1889*).—One new case.

Second result (*October 10, 1890*).—Four new cases, including one doubtful. The case of 1889 has not recovered, and the cases of 1888 have been dug out.

Third result (*October 5, 1891*).—Including one doubtful, there are three new cases. The tree which was doubtful last year now shows distinct symptoms.

Fourth result (*October 6, 1892*).—Five new cases, including one doubtful. The suspect of last fall shows plain symptoms.

THIRTY-SIXTH CONTROL.

Preliminary examination (*May 14, 1889*).—This plat joins LXXXII on the south, and is comparable with any of the treated plats which surround it. Originally there were 77 trees in a rectangle 7 by 11. It now contains 68 healthy trees; 6 cases of 1888; and three vacant places.

First result (*September 17, 1889*).—No new cases.

Second result (*October 10, 1890*).—Six new cases, including two doubtful. Two of the cases of 1888 have been dug out. The rest are still diseased.

Third result (*October 5, 1891*).—No new cases. One of the two doubtful trees now shows distinct symptoms and the other does not, although it is far from being a healthy tree.

Fourth result (*October 6, 1892*).—Four new cases. The suspect of two seasons now shows distinct symptoms.

EXPERIMENT LXXXIV.

Preliminary examination (*May 21, 1889*).—This plat is north of the west end of LXXVIII. The surface is level; the soil is clay loam with a porous yellow clay subsoil. Originally there were twenty-five trees in a square, but two have disappeared. Of the remainder twenty-two are healthy and one is a case of 1888.

First treatment (*May 21, 1889*).—Each tree was dosed with 3 pounds of a peach-tree fertilizer known as "Hubbard's Fruit Grower," made by T. R. Hubbard & Son, Chestertown, Md. It was carefully weighed and measured out and spread evenly under the branches from the trunk outward, so that the whole surface of the plat was covered. The sowing was made in a still air on moist cultivated earth, after a prolonged heavy rain. The fertilizer was purplish gray with the smell of hen manure and the taste of guano and kainit. It appeared to be composed of guano, kainit, and acidulated ground fish. The table of analysis printed on the sacks stated the composition to be as follows:

	Per cent.	
Ammonia from natural guano	½ to	1
Available bone phosphate	13	15
Bone undecomposed	6	8
Potash from potash salts	6	8

The fertilizer was cultivated in some days later.

First result (*September 17, 1889*).—No new cases. The old one has been dug out.

Second treatment (*May 16, 1890*).—Each tree received 4 pounds of Hubbard's Fruit Grower. This mixture, stated to be identical with that furnished in 1889, was a heavy, reddish fertilizer, ground finer than last year. It cost $25 per ton. It was sown evenly under the branches, covering about two-thirds of the whole surface of the plat. It fell upon moist earth and was harrowed in a few days later—*i. e.*, as soon as the soil was dry enough.

Second result (*October 11, 1890*).—No new cases.

REMARK.—The treatment was abandoned.

Third result (*October 5, 1891*).—The plat is still free from new cases.

Fourth result (*October 6, 1892*).—Two cases, including one suspect.

Experiment LXXXV.

Preliminary examination (May 21, 1889).—This plat is of the same size as the preceeding and joins it on the north. The soil is the same and the trees are also comparable. Twenty-four are healthy and one is a case of 1888.

First treatment (May 21, 1889).—Each tree was dosed with 5 pounds of Hubbard's Fruit Grower, applied in the same manner as on LXXXIV.

First result (September 17, 1889).—No new cases. The old case has not recovered.

Second treatment (May 16, 1890).—Each tree received 8 pounds of Hubbard's Fruit Grower, which was put on and harrowed under in the same manner as on LXXXIV.

Second result (October 11, 1890).—The diseased tree has been dug out. One other tree, healthy in 1889, is now very suspicious. The rest are free from disease and thrifty.

Remark.—The treatment was abandoned.

Third result (October 5, 1891).—The suspect of last year is now plainly diseased, but there are no new cases.

Fourth result (October 6, 1892).—Four new cases, including two suspects.

Experiment LXXXVI.

Preliminary examination (May 21, 1889).—This plat joins the last on the north and is identical with it in character of soil and appearance of trees. The surface is very level. There are twenty-five trees in a square, and all are healthy.

First treatment (May 21, 1889).—Each tree was dosed with 8 pounds of Hubbard's fruit grower, which was put on in the same manner as on the other plats.

First result (September 17, 1889).—One case. All of the others are healthy. The trees have made a good growth.

Second treatment (May 16, 1890).—Each tree received 12 pounds of the same fruit grower, which was put on and harrowed under in the same way as on the other plats.

Second result (October 11, 1890).—One new case. The old case has not recovered.

Remark.—The treatment was abandoned.

Third result (October 5, 1891).—The old cases are worse than last year, but no new ones have appeared.

Remark.—Of these three plats that which received least is now freest from disease. All have been quite free from cases, but so have the controls (see Plate XXIX).

Fourth result (October 6, 1892).—Four new cases, including one doubtful.

FORTY-SIXTH CONTROL.

Preliminary examination (May 21, 1889).—This plat joins LXXXIV on the east. It contains twenty-four healthy trees and one vacant place.

First result (September 17, 1889).—Two cases.

Second result (October 11, 1890).—One new case.

Third result (October 5, 1891).—Two new cases.

Fourth result (October 6, 1892).—No new cases.

FORTY-SEVENTH CONTROL.

Preliminary examination (May 21, 1889).—This plat joins the last one on the north and LXXXV on the east. It contains twenty-one healthy trees; three cases of 1888; and one vacant place.

First result (September 17, 1889).—No cases.

Second result (October 11, 1890).—No cases.

Third result (October 5, 1891).—No cases.

Fourth result (October 6, 1892).—One suspect.

FORTY-EIGHTH CONTROL.

Preliminary examination (*May 21, 1889*).—This plat joins the last one on the north and LXXXVI on the east. It contains twenty-four healthy trees and one vacant place.

First result (*September 17, 1889*).—No cases.

Second result (*October 11, 1890*).—No cases.

Third result (*October 5, 1891*).—No cases.

Fourth result (*October 6, 1892*).—Five cases, including one doubtful.

EXPERIMENT LXXXVII.

Preliminary examination (*November 1, 1889*).—This experiment consists of the scattered trees 1, 2, 4, 5, 6, 7, 8, 9, 14, 15, and 16 forming part of the excision experiments of 1888, and of one additional tree not included in that experiment. All showed slight but unmistakable symptoms of yellows on one or more main limbs in the summer of 1888, and all are still affected in varying degrees, although apparently in some cases I very nearly succeeded in cutting out the disease.* The tree marked X is a case of 1889 not cut back. All of the trees are on a level clay loam, with a subsoil of yellow clay. A curative treatment was undertaken as follows:

Treatment (*November 1, 1889*).—Each tree was dosed with 150 pounds of strong, unleached, hard-wood ashes. These were distributed evenly from the trunks to beyond the spread of the branches and were at once thoroughly dug into the earth.

First result (*October 10 and 11, 1890*).—The condition of each of these trees, except X, is set forth in Bulletin No. 1, of the division of vegetable pathology, 1891. None of them gave any indications of recovery as a result of the treatment. The tree marked X looks very sick. Most of its foliage has fallen. It is very twiggy, but its winter buds are not now unfolding.

REMARK.—It was not considered expedient to make any additional treatment, but the soil was cultivated as usual and the trees were retained for further study.

Second result (*October 5, 1891*).—The condition of each tree was as follows:

(1) Badly diseased. There are no dead limbs of any considerable size, but many small ones have died. None of the foliage is healthy. The leaves are undersized, more or less rolled and curled, and redder than natural. Winter buds are unfolding.

(2) In the spring this tree was cut back by mistake to the base of the main limbs. It has sent out shoots in abundance from near the earth, and each one is diseased and much branched. Some of the shoots are very pale and spindling, while others bear good foliage. Winter buds are unfolding.

(3) This tree is still alive in all parts, but is diseased throughout. The leaves are smaller and redder than normal. Many winter buds are unfolding. Others unfolded in July or August, especially terminal ones in the top of the tree. Of such there are more than one hundred (see Plate XIII.)

(4) The tree is still alive in all parts, but the foliage is abnormally red, and winter buds are unfolding on the trunk and all of the main limbs.

(5) The foliage is more abundant and more nearly normal than on any tree previously mentioned. It is of good size and not unnaturally red or yellow, but winter buds are unfolding in a few places, showing that the tree has not been restored.

(6) This tree bears nearly normal foliage somewhat like that on No. 5, but the symptoms of disease are more numerous. Several robust stem sprouts are badly diseased and there are more dead branches than on No. 5.

(7) This tree is a bad case. The branches are very twiggy, owing to the number of diseased shoot-axes, and the foliage is badly dwarfed, rolled, and curled. Winter buds have unfolded freely since June, and a few are still doing so.

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* For the exact condition of each tree see *Additional Evidence on the Communicability of Peach Yellows, etc.*, 1891, p. 29.

(8) There are symptoms of disease in all parts of the tree, and no signs of recovery. The foliage is unnaturally red, rolled, and curled.

(9) Some of the smaller branches have died, and there are no signs of recovery. The foliage is rather abundant, dwarfed in part, however, and rolled, and some of it abnormally red. Many winter buds are unfolding on each main limb.

(14) The tree bears no normal foliage. It is dwarfed, rolled, and curled, and a small part of it is also unnaturally red. There are a good many dead twigs. Winter buds have been unfolding since midsummer and are still doing so.

(15) This is a bad case. The foliage is scanty, rolled, curled, and red. Very little of it is natural size. Winter buds have unfolded in the top of the tree since midsummer. The base of a limb also bears an unfolding bud and a diseased branched shoot.

(16) This tree bears many dead twigs and is diseased in all parts. The foliage is much dwarfed and unnaturally red. Many winter buds have unfolded since midsummer, especially in the top of the tree, and some of the shoot-axes are still growing. A few buds are still unfolding. The greater part of the tree is still alive, only a few of the smaller branches having died.

Third result (*October 6, 1892*).—All are very sickly.

EXPERIMENT LXXXVIII.

Preliminary examination (*November 1, 1889*).—This experiment, like the last, consists of isolated, diseased trees, all but one of which formed part of the excision experiments of 1888. The soil occupied by each tree is level clay loam, with a yellow clay subsoil.

The trees are 12, 13, 17, 18, 19, 20, and X′, and the history down to October 11, 1890, of all but the latter, may be found in Bulletin 1. The tree marked X′ is a case of 1888, which, like others, was cut back to the base of the main limbs in the spring of 1889 by the tenant, who then intended to dig out the stubs, but neglected to do so. In the season of 1889 this stub developed branches of unusual size and vigor for a diseased tree. These shoots still bore symptoms of yellows. All but a few of the best-looking were removed. These had borne good foliage, and gave no indication of disease except a few feeble sprouts at their bases.

Treatment (*November 1, 1889*).—A duplicate of LXXXVII except that the ashes were not dug into the soil, but were plowed down the following spring. The ashes used in both experiments were of uniform appearance, and very biting.

First result (*October 11, 1890*).—None of the trees show any material improvement. The tree marked X′ is growing a new top. It is rather vigorous, but still affected by yellows. The foliage is of good size and abundant, but it is reddish and yellowish as a result of the disease, and is somewhat rolled and curled, and some winter buds are unfolding. The leaves have that peculiar tint of yellow hard to describe, but very characteristic of vigorous leaves when struck by yellows, and after some experience, quite easy to recognize before premature fruit or other symptoms are seen.

REMARK (April 27, 1891).—The young foliage on these trees and those of experiment LXXXVII is paler or more reddish and less vigorous than on neighboring healthy trees. Usually a diseased tree can be picked out without difficulty by the changed color of the unfolding leaves.

Second result (*October 5, 1891*).—The condition of each tree is as follows:

(12) There are not many dead branches, and the tree looks very well—much better than 1 to 9. It bears abundant foliage of normal size, but some of it, especially on the water-shoots, is redder and yellower than natural, and peculiarly curled. Winter buds are also unfolding on two branches, showing that the tree has not recovered.

(13) This tree looks very well. For the time of the year it bears a normal amount of good-looking foliage. No winter buds are unfolding and very few of the leaves

are rolled or curled, but there are still obscure signs of disease in the top of one branch. This evidently bore premature fruit, is quite twiggy, and the twigs and some of the smaller branches are dead.

(17) The stub now bears six branched shoots, each of which is 5 or 6 feet long, and 1½ to 2 inches in diameter at the base. One or two bear good-looking foliage, but on most it is rolled and curled and red and yellow in part, as a result of disease. These shoots are very twiggy from the death of spindling, weak, side branches, and on each one winter buds are now unfolding or have unfolded since July. The stub also bears one sprout of this year's growth 2 feet long, on which, since midsummer, seventeen lower buds have pushed into feeble spindling shoots 1 to 5 inches long and about one-sixteenth of an inch in diameter. Some weeks ago the terminal bud unfolded into a whorl of leaves which are still growing and fourteen other buds are now unfolding. All but one of the spring leaves have fallen from this shoot and that one is yellow.

(18) This is still a good looking tree and shows no signs of disease at a distance. The foliage is abundant, of good size and normal appearance, except part on two small branches, which is reddish yellow and curled. The tree is still diseased, but the symptoms are not pronounced. In summer some one cut diseased branched shoots from one limb. The tree seems likely to live several years.

(19) Still plainly diseased. Part of the foliage is normal. The rest is red, yellow, and curled. A few winter buds are unfolding.

(20) This tree is alive in all parts and still possessed of plenty of leaves, but many of them are small, red, rolled, and curled. Winter buds are now unfolding in many places and whorls of immature leaves arising from winter buds which unfolded as early as June or July are scattered all over the top of the tree. A bad case.

(X′) This stub is now badly diseased.

Third result (*October 6, 1892*).—No recoveries. All much worse than last year.

GENERAL REMARKS ON LXXXVII AND LXXXVIII.

1891: With exception of two or three trees, the whole lot look worse than last autumn. They have not made more growth than their surrounding, untreated fellows, nor is the foliage any greener. The most that can be said in favor of this treatment is that while none of the trees have been restored their decay appears to have been retarded. Possibly the conclusion also is unwarranted. Another year will probably yield more decisive results.

1892: The trees failed noticeably this year, although the orchard was plowed and cultivated as usual.

EXPERIMENT LXXXIX.

Preliminary examination (*April 27, 1891*).—This plat consists of a large rectangle on the west side of the orchard. The soil is clay loam, and the surface is level except for a very slight inclination of the south half toward the south.

Originally there were 139 trees. The cases by years on this plat have been as follows: 1887, 20 (?); 1888, 4; 1889, 2; 1890, 12. As the block now stands there are 2 cases of 1889, 12 of 1890, and 95 healthy trees, making a total of 109. These trees are large and the branches touch or nearly touch.

Treatment (*April 27, 1891*).—Each tree was given 10 pounds of nitrate of soda. This was sowed pretty uniformly over the surface and was plowed down some days later.

REMARK.—This experiment was undertaken on account of the results in Mr. Greene's orchard on the plat dosed with guano (Exp. XLIII).

First result (*October 5, 1891*).—Including two doubtful there are only four new cases, and one of these probably belongs to the period between October 11, 1890, and April 27, 1891. The old cases have not been cured. These trees have been conspicuous for vigor of growth throughout the season. They still bear an enormous quantity of smooth, dark-green leaves—*i. e.*, 4 to 6 times as many as the control trees. There are no green leaves on the checks and not many of any sort at this date, and what remain are small, while on the nitrated plat comparatively few of the leaves have fallen or are yellow (see Plates XIV and XV). The effect of the fertilizer can be seen a mile away. The trees have made double as much growth as their fellows, but have not broken down with the superabundent weight of foliage, as in the case of some of the younger trees of Series XI. The last of the Smock, picked from trees on this plat, were eatable to-day, while the peaches of this variety were gathered from the untreated rows some weeks ago.

REMARK.—It would seem that the insufficient element in this soil, if any, must be nitrogen. The experiment is a failure, so far as showing any injurious effect of nitrogen other than that due to excessive growth, retarded ripening of the fruit and foliage, and the increased tendency of the fruit to rot on account of the excessive shade and moisture. The nitrogen did not determine an increase of yellows.

Second result (*October 6, 1892*).—Twenty-one new cases. The two which were doubtful last year are still doubtful. The contrast in greenness between this block and the rest of the orchard has been marked throughout the season. The trees still bear many green leaves and can be distinguished one-half mile away. In this case the nitrate of soda produced its characteristic effect throughout the whole of the second season.

GENERAL REMARKS.

1889: *May 14.*—The orchard was plowed and cultivated some weeks ago and the soil is now in a clean, satisfactory condition. All the trees selected for treatment were reëxamined at this time and, with a few exceptions, noted on the map, those which were healthy last August are still healthy. The controls were not reëxamined for new cases. The trees have made a large growth during the past two years.

The fertilizers were sown evenly under each tree top as far out as the spread of the branches and, since the latter now touch or nearly touch, the substances went on evenly over almost the entire surface of the plats, but none was allowed to touch the trunks.

The sowings were made upon wet earth after rains. Two heavy rains also occurred soon after. The soluble parts of the fertilizers deliquesced at once and passed into the soil. The plats were not harrowed immediately, but a week or two afterward, when the whole orchard was cultivated.

September 17.—The season was unprecedentedly rainy from early spring until August. The orchard was cultivated soon after treatment and several times during the summer, but it is now grassy and weedy. The trees blossomed full, but the few peaches which escaped *Monilia fructigena* at the outset rotted in May and June and the entire orchard produced only 20 baskets of ripe fruit.

Each tree was examined with great care, the more so because there was no fruit to guide in the detection of new cases. There has been a very marked falling off of cases this season. Excluding cases noticed in the spring of 1889 and probably to be referred to 1888, there are only sixty cases of yellows this year, including doubtfuls, while they numbered 318 in 1887 and 301 in 1888. There is a general belief all over upper Maryland and Delaware that the yellows has not spread this year. It is certain there has been no marked increase of cases anywhere, while in many orchards the cases have by actual count fallen off from one-half to three-fourths. In most places this fact has been coincident with an absence of fruit. There are some difficulties, however, in ascribing the decrease to the absence of fruit, for I am told that there have been very few prematures this year even in orchards which bore their usual crop, and in one orchard near Still Pond a variety which happened to bear a full crop is certainly freer from new cases than a neighboring variety which bore none, although soil and other conditions are apparently the same.

In Mr. Harper's orchard the treated areas shared the general immunity, but are less free than the control areas, and only a little freer than the rest of the orchard, although presumably more favorably situated, in that diseased trees are not mixed in with healthy ones to the same extent as on the controls, and especially on the rejected portions. A number of the treated plats developed no new cases, but the same is true of several controls, and no definite conclusions can be drawn. Most of the cases of 1888 were cut back to the base of the main limbs some time between fall and spring and before they blossomed, but only a few were dug out. Some of these stubs are dead, but a majority have sent out a mass of diseased shoots, while two bear shoots which seem to be entirely healthy. About twenty of these trees were missed in topping back, and are now badly diseased.

October 30.—The orchard has shed its foliage, and treated and untreated portions can not be distinguished.

November 30.—There was much rainy weather during this month.

1890: *May 16.*—The trees are growing rapidly and the orchard looks very well. The spring shoots are 2 to 3 inches long, so that the trees now give considerable shade. Owing to general climatic influences, there is no fruit, except here and there a peach now about one-half inch in diameter. The ground was plowed about a week ago and will be harrowed in a few days.

October 11.—The orchard has not been cultivated since July and is grassy and weedy. There is little difference in color of foliage or appearance of trees on treated and untreated parts, but Mr. Price, the tenant, says the effect of the treatment was plainly visible earlier in the season. The season's wood is well matured in all parts of the orchard and there is no dark green foliage on any of the trees. Nine-tenths of the leaves have fallen and the rest are yellowing (autumn ripeness). The foliage on the diseased trees is very red, irrespective of varieties or of treatment. This feature is so marked that most diseased trees can be picked out before one is near enough to find diseased shoots and the unfolding winter buds. Possibly there is something seasonal in this color; at least this is the first year I have been especially impressed by it. It is not confined to this orchard.

The trees have grown much during the past four years and the outer limbs now touch, or nearly touch, or lap in some cases. This alone is evidence of a good soil, since they are 20 feet apart.

There was no fruit this year, and yet there are three times as many cases as in 1889. This shows pretty conclusively that the decrease of cases that year can not be attributed to absence of fruit. The year 1890 was marked over the whole peninsula by an almost complete absence of fruit, and yet there has been a very large increase of cases; in a great many orchards more than in 1888, which was a year of overproduction.

The cases in this orchard (see Plate XXIX) have been pretty uniformly distributed, and have developed without much reference to treatments.

1891: *April 27.*—The orchard has not been plowed this spring, but will be within a very few days.

The trees were trimmed pretty vigorously this spring by the tenant, and if there is such a thing as spreading yellows by the saw and pruning knife this ought to do it.

As indicating the heavier and colder nature of the soil, asparagus was large enough to cut for shipment at Mr. Shallcross's, in the vicinity of Orchard XII, five days earlier than on this farm. There are some new cases of yellows since last fall.

The fertilizers were sowed, as usual, in still weather and fell upon a rather hard, dry soil covering two-thirds to three-fourths of the whole surface of each plat, *i. e.*, the parts nearest to the tree.

The tops of the cases of 1889 and 1890, exclusive of the few under treatment, were cut away this spring before blossoming.

May 19.—The first rain of some weeks fell upon May 3. This was a thunderstorm, followed by a gentle rain of some hours' duration. The soil was wetted to a depth of 5 inches. It was plowed next day and harrowed soon after, and is now in good condition.

October 5.—The orchard produced about 4,000 baskets of fruit, the first crop since 1888. The healthy peaches were large and fine, especially on the treated plats. The orchard was replowed in summer and is not very weedy.

There is now no perceptible difference in the amount or color of the foliage on the treated and untreated plats, excepting, of course, the one which received the nitrate of soda. That is very green. On the rest of the orchard three-fourths of the foliage has fallen, and much that remains is yellowing.

As last year, many of the diseased trees bear very red foliage. This is particularly striking on Plats LXXVII, LXXVIII, LXXIX, and LXXX.

October 11.—The ripening of the fruit was noticeably retarded by the application of the nitrate of soda, and these trees are still very leafy and green (see Plate XIV). The amount of foliage and general appearance of the center of the orchard at this date is shown on Plate XVI, the camera being set at the northwest corner of Experiment LXXXVI, pointing east.

The cases of yellows have not been more numerous than last year, *i. e.*, a crop of fruit did not determine an excess of cases. The cumulative evidence on the value of the treatments will be discussed in the following summary.

1892: *October 7.*—The orchard was plowed and cultivated as usual this year, and is now covered with low grass and weeds.

The trees bore no fruit, not even one basket. This was owing to general conditions affecting all the orchards—spring frosts (?).

The wood is well ripened and the trees have shed most of their leaves, except on the plat which received nitrate of soda in the spring of 1891.

It is difficult to distinguish new cases on account of the time of year and the presence of comparatively few diseased sprouts and unfolding winter buds, due, probably, to the dry autumn. In many instances the foliage of the diseased trees is abnormally red, but not in all.

I am more than ever impressed by the big growth which these trees have made during the last five years. It is certainly indicative of a good soil. In many instances the tops lap far by and the roots of diseased and healthy trees have undoubtedly interlaced for a number of years, but this has led to no increase of cases, the most cases having appeared in years when the roots did not so fully occupy the soil.

SUMMARY.

The cases and per cent of cases, by years, is shown in the following table:

TABLE XXVI.—*Showing the progress of peach yellows on 2.954 trees in the orchard of F. H. Harper, Still Pond, Md. (Plate XXIX.)*

Year.	Cases.	Per cents.	Year.	Cases.	Per cents.
1881	0	0.	1888	301	10.2
1882	0	0.	1889	*67	2.3
1883	0	0.	1890	195	6.6
1884	0	0.	1891	192	6.5
1885	0	0.	1892	193	6.5
1886	4	0.1			
1887	318	10.8	Total	1,270	43.0

*Includes 7 cases which occurred between August 6, 1888, and May 15, 1889, and which belong as properly to 1883.

From this table it will be observed that the orchard was free from disease for 5 years, and that during the next three years the disease followed much the same course as in Mr. Greene's orchard (Series III). In 1889 the per cent of new cases was much less, and thereafter the cases in the two orchards are less comparable. Whether the cutting down of most of the diseased trees in Mr. Harper's orchard year by year and their retention in Mr. Greene's had anything to do with this final difference is a matter on which there is not enough evidence to speak unqualifiedly, but I am inclined to think that retention of the diseased trees favored the spread of the disease. As in most of the other orchards, the most striking feature is the unexpected and marked diminution of new cases in 1889, followed by an increase in 1890, 1891, and 1892. It is worthy of note that this decrease of cases in 1889 followed a year of overproduction.

The following table gives the number of healthy trees at the beginning of the experiments, and the cases, by years, since the spring of 1889, on the treated and the untreated plats, as indicated on Plate XXIX. The totals and per cents are also added:

TABLE XXVII.—*Showing, by cases and per cents, the general results of preventive treatments begun in the spring of 1889 in the orchard of F. H. Harper, Still Pond, Md. (Consult Plate XXIX for location of plats.)*

[Those which received extra doses of muriate of potash are marked +.]

Plat.	Treatments (646 healthy trees).						Plat.	Controls (852 healthy trees).					
	No. of healthy trees.	Cases each autumn.				Total cases.		No. of healthy trees.	Cases each autumn.				Total cases.
		1889.	1890.	1891.	1892.				1889.	1890.	1891.	1892.	
LXII	62	2	2	3	10	17	33	107	1	8	7	8	24
LXIII+	54	4	6	5	1	16	34	73	0	7	2	4	13
LXIV	24	0	4	1	4	9	35	63	1	4	3	5	13
LXV+	20	0	0	2	2	4	36	68	0	6	0	4	10
LXVI	36	2	3	0	3	8	37	110	1	7	9	8	25
LXVII+	36	0	1	7	6	14	38	50	0	4	2	2	8
LXVIII	20	0	3	5	4	12	39	47	0	2	6	7	15
LXIX+	20	2	4	6	3	15	40	123	0	14	13	12	39
LXX	14	0	1	7	2	10	41	46	0	1	6	2	9
LXXI+	15	0	2	8	2	12	42	62	3	3	4	4	14
LXXII	19	0	4	8	0	12	43	3	0	0	0	0	0
LXXIII+	12	1	1	5	1	8	44	3	0	0	0	0	0
LXXIV+	6	0	0	0	1	1	45	28	0	3	3	3	9
LXXV	25	1	5	2	1	9	46	24	2	1	2	0	5
LXXVI+	23	1	3	3	3	10	47	21	0	0	0	1	1
LXXVII	35	0	8	3	2	13	48	24	0	0	0	5	5
LXXVIII+	48	0	7	1	0	8							
LXXIX	24	0	0	0	1	1							
LXXX+	23	0	4	3	2	9							
LXXXII	23	0	1	0	0	1							
LXXXIII+	36	0	5	3	0	8							
LXXXIV	22	0	0	0	2	2							
LXXXV	24	0	1	0	4	5							
LXXXVI†	25	1	1	0	4	6							
Total	646	14	66	72	58	210	Total	852	8	60	57	65	190
Per cent	....	2.2	10.2	11.1	9.0	32.5	Per cent	....	0.9	7.0	6.7	7.6	22.3

† Plat LXXXIX is excluded because treatment did not begin until the spring of 1891, and was to induce yellows rather than to prevent it.

In making this comparison considerable portions of the orchard were not used. These rejected parts are considered, however, in the following table:

TABLE XXVIII.—*Showing changes which have taken place in healthy trees in the orchard of F. H. Harper, Still Pond, Md., since the spring of 1889.*

Areas.	No. of healthy trees.	Per cent of cases of yellows.				Total.
		1889.	1890.	1891.	1892.	
Entire orchard	2,244	2.7	8.7	8.6	8.6	28.5
Treated plats	646	2.2	10.2	11.1	9.0	32.5
Controls	852	0.9	7.0	6.7	7.6	22.3
Rejected portions	746	5.1	9.2	8.4	9.4	32.2
Orchard, exclusive of treatments	1,498	3.1	8.6	8.0	9.0	28.7

*Plat LXXXIX is included in rejected portions.

This table shows that the treated plats developed more cases than any other parts of the orchard, or than the average of the whole of it. They were freest from disease at the start, but are now slightly worse than even the rejected portions. As compared with the controls, they have developed nearly one-third more cases.

The interest, however, centers largely around the Goessmann-Penhallow treatments, which were thoroughly tested in all parts of the orchard. The other treatments included in the preceding tables do not materially modify the general conclusions, but the following table gives these results separately, contrasting the ten plats, which received four treatments with the adjoining plats, which received the same treatments, and also two extra ones of muriate of potash, advised by Prof. Penhallow in case the trees showed much indication of disease, and put on these healthy trees with a view to forestalling the yellows.

TABLE XXIX.—*Showing per cent of cases of yellows by years on twenty plats treated with the Goessmann-Penhallow mixture in the orchard of F. H. Harper, Still Pond, Md.*

Plat.	No. of healthy trees in spring of 1889.	Per cent of cases.				
		1889.	1890.	1891.	1892.	Total.
Four treatments (282 trees).						
LXII	62	3.2	3.2	4.8	16.1	17.3
LXIV	24	0.0	16.6	4.2	16.6	37.4
LXVI	36	5.6	8.3	0.0	8.3	22.2
LXVIII	20	0.0	15.0	25.0	20.0	60.0
LXX	14	0.0	7.1	50.0	14.3	71.4
LXXII	19	0.0	21.1	42.1	0.0	63.2
LXXV	25	4.0	20.0	8.0	4.0	36.0
LXXVII	35	0.0	22.9	8.6	5.7	37.2
LXXIX	24	0.0	0.0	0.0	4.2	4.2
LXXXII	23	0.0	4.3	0.0	0.0	4.3
Total	282	**1.8**	**11.0**	**10.3**	**9.6**	**32.7**
Four treatments, plus two extra treatments with muriate of potash (287 trees).						
LXIII	54	7.4	11.1	9.3	1.9	29.7
LXV	20	0.0	0.0	10.0	10.0	20.0
LXVII	36	0.0	2.8	19.4	16.7	38.9
LXIX	20	10.0	20.0	30.0	15.0	75.0
LXXI	15	0.0	13.3	53.3	13.3	79.9
LXXIII	12	8.3	8.3	41.7	8.3	66.6
LXXVI	23	4.3	13.0	13.0	13.0	43.3
LXXVIII	48	0.0	14.6	2.1	0.0	16.7
LXXX	23	0.0	17.4	13.0	8.7	39.1
LXXXIII	36	0.0	13.9	8.3	0.0	22.2
Total	287	**2.8**	**11.5**	**15.0**	**7.0**	**36.3**

From the preceding tables it will be observed, as already stated, that the treated plats developed more cases each year than the controls, and that as the treatments progressed the per cents rose above the average of the whole orchard, although the plats were selected on account of their freedom from disease.

Table XXIX also shows that of the ten double plats treated with the Goessmann-Penhallow mixture the north portions, *i. e.*, those which received extra treatments with the so-called "specific," muriate of potash, actually developed more cases than the others, the per cents being 29.3 to 23.1 at the end of third year, and 36.3 to 32.7 at end of the fourth year.

SERIES X.—ORCHARD OF J. FRANK WILSON, STILL POND, MD.

This orchard is about 1 mile northwest of No. IX on an adjoining farm. It consists of 20 or 30 acres of rolling land, about 100 feet above the river, and nearer to it than IX. The trees were set in 1886 and 1887 and many have been removed already on account of yellows. The whole orchard was not examined, but two plats were selected for experiments with tobacco dust.

EXPERIMENT, XC.

Preliminary examination (*September 19, 1889*).—This experiment consists of a group of sixteen trees on a flat, rather moist loam in the center of the orchard. The trees are not suffering from yellows but are badly dwarfed and have diminutive rolled and purplish-spotted foliage. They are like many other trees on the roots of which the black aphis occurs and have undoubtedly been dwarfed by this insect. A careful search on the roots of several trees brought to light colonies of the yellow ant, generally associated with the aphis, but failed to show any of the latter. Such trees have often been mistaken for cases of yellows, and it is possible that some of the many "cures" have been performed on such trees, especially in New Jersey, where this insect is common. The other trees in the orchard are 8 to 10 feet high, but these are so small as to be nearly overgrown and hidden by a rank growth of *Polygonum persicaria*.

First treatment (*September 19, 1889*).—The dense growth of smartweed (*Polygonum persicaria*) was cleared away and 1½ bushels of strong tobacco dust was dug into the earth around each tree, it having been distributed thickly as far out as the branches extended, and beyond in case of the smallest trees.

Second treatment (*May 16, 1890*).—Each tree was given about 2½ bushels (54 pounds) of fine strong tobacco dust, except that the quota belonging to one of the sixteen trees, now dead to the earth, was given to a neighboring tree somewhat less dwarfed. The trees are so small that the coating of dust extended several inches deep from the trunks to beyond the spread of the branches. It was dug into the earth at once.

First result (*October 9, 1890*).—Every one of the fifteen trees which received two treatments has made several times as much growth as usual, and the foliage is in very marked contrast to that of last year, or to that on untreated trees. The following note on one of the worst trees will be sufficient to show the effect of this treatment.

No. 9, which was one of the very weak and stunted trees, is now a good thrifty tree. The foliage is large, smooth, bright, green, and entirely free from spotting, rolling, or curling. The change is remarkable. The best leaves measure 8½ by 1⅞ inches, and no one would suppose that it had ever been a stunted tree. The best terminal shoots have grown 25 inches, and fully a fourth of them have made two growths this season. The leaves have fallen from the first growths while the second growths are now nearly mature, and bear full grown, handsome green leaves, the above measurement being from one of them. The length of these stout secondary shoots is 4 to 9 inches. The occurrence of two healthy growths in one season is very rare except in the far South. The tree is surrounded by an extraordinary growth of *Datura stramonium*. The tree which received only one treatment has made sufficient growth but the foliage is yellowish-green and considerably rolled and curled.

REMARK.—It was not considered necessary to repeat the treatment.

Second result (*May 19, 1891*).—These trees are very vigorous and growing rapidly. At this rate they will soon overtake the rest of the orchard. The foliage is a handsome green and one would never suspect them of having been stunted.

Third result (*October 5, 1891*).—The original fifteen are fine trees, having entirely recovered. The tree which received only one (spring) treatment now has yellows. The one which died to the ground is growing a new vigorous top. The other trees bear more foliage than the surrounding ones, and the leaves are larger, smoother, and greener. No one would suspect these trees to be the miserable dwarfs given up as hopeless two years ago. That the tobacco is still acting is shown by the greener foliage and the larger growth of the weeds which, however, are not so rank as last year. Other trees in this orchard have shed a large part of their leaves and the rest are yellowing. Number 12, a Smock, still bears three edible peaches, which is evidence of retarded development.

The appearance of one of these trees nine days later is shown on Plate XVII, the white papers placed on the branches marking the growth made in two years. The trees bore fruit this year for the first time.

EXPERIMENT XCI.

Preliminary examination (*September 19, 1889*).—Six trees affected by yellows were selected for this experiment. They are in the same orchard on a barren-looking side hill in red clay which contains stones and does not specially favor the growth of weeds. They are cases of this year, diagnosed by the diseased sprouts, and in some instances also by the color and curling of the spring foliage. No. 3, however, shows no trace of disease except at the base of two small limbs, on each of which a tiny, feeble shoot has developed since mid-summer.

Although the soil has washed and looks poor, the trees on the slope have made a very good growth, being large enough for their age. They are set about 20 by 20 feet apart, and do not occupy more than one-fourth to one-third of the ground.

First treatment (*September 19, 1889*).—Each tree was given one bushel of strong tobacco dust. This was evenly distributed and carefully dug into the earth under the branches, the aim being to cover the ground over a diameter equal to the spread of the roots.

Second treatment (*May 16, 1890*).—Each tree received 1½ bushels (36 pounds) of fine strong tobacco dust. It was sowed as far out as the spread of the branches and dug into the earth at once. One of these trees is much dwarfed and badly diseased; the other five are not yet bad cases.

First result (*October 9, 1890*).—The condition of each of these trees is as follows:

(1) Greener than its fellows, but full of diseased shoots. Much of the spring foliage is curled and stunted, and many winter buds are now pushing.

(2) Greener than its fellows, and at least as good looking as last year. Does not look cured, but is worth watching. The foliage is curled, but no winter buds are pushing. The grass and weeds have made a rank growth.

(3) Much greener than its fellows. It has made a good growth this year, but it bears quite a good many diseased shoots, and winter buds have unfolded recently.

(4) Greener, but not recovered. The foliage is curled, and a few winter buds are now unfolding. A large growth of grass and weeds.

(5) Greener, but not recovered. The foliage is curled, and a few winter buds are pushing. A big growth of grass and weeds.

(6) Dead. This is the bad case of last spring. A big growth of grass and weeds.

REMARK.—The great quantity already used seemed to render further treatment unnecessary.

Second result (*October 5, 1891*).—The condition a year later was as follows, the orchard meanwhile having received the ordinary cultivation:

(1) Gone. The effect of the treatment is still visible in a big growth of grass and weeds.

(2) Still diseased and almost dead. Only thirteen spring leaves remain. The effect of treatment is still visible in the larger growth of grass and weeds.

(3) Diseased in all parts. Foliage scanty, very red and yellow. Many winter buds unfolding. The tree bore premature fruit, which rotted early and still hangs. Slightly more grass and weeds than on the untreated.

(4) Tree reduced to a stump, which bears badly diseased sprouts. Grass and weeds tall, showing that the influence of the tobacco persists a second season.

(5) Diseased in all parts. Foliage red and scanty. Many winter buds unfolding. The tree bore premature fruit, which rotted early and still hangs. There is a distinctly taller and more copious growth of grass and weeds where the tobacco fell.

(6) The grass and weeds are taller and four times as abundant as on untreated.

There are now many cases of yellows on this hillside and in other parts of the orchard, and the east half has been pulled out on account of it. The negative results of this experiment agree substantially with those of XLIV, at Mr. Greene's (Series III), and are especially interesting when contrasted with the positive results of Experiment XC, in this same orchard.

SERIES XI.—ORCHARD OF J. FRANK WILSON, STILL POND, MD. (Plate XXX.)

This orchard is about 5 miles from Series X on the home farm near the village. It occupies the east field north of the highway. The field contains about 14 acres, but a marsh encroaches on the east side (see map).

The trees came from the nursery of Norris Barnard, near Still Pond, Md., and were set in the spring of 1887 at a distance apart approximating 20 by 20 feet. The total number of trees planted amounted to about 1,450. The orchard contains nearly a dozen varieties, most of which are early fruit.

The orchard was well cultivated and otherwise well cared for from the time it was planted, having received Mr. Wilson's personal attention. Exclusive of a few "die outs," of some trees in the northeast corner along the gravel ridge, and of a few bordering the bottom and subject to excess of water, the trees made a good growth during the first three years, and were well developed and handsome in the summer of 1889.

The orchard has been pruned in the ordinary way, *i. e.*, by the removal of superfluous or lopsided branches so that the tree might form an even, rounded, spreading top. The branches were never shortened in.

The first cases of yellows (see Plate XXX) appeared in the summer of 1889, when the trees had been set two and one-half years. Nine trees were affected. Three of these were on level loam in the north part of the orchard and six were on lighter, sandy, and gravelly land in the southeast part. These trees appeared to be healthy in 1887 and 1888 and made a large growth, but they were so thoroughly diseased in 1889 that it was almost impossible to avoid the conclusion that the disease had been dormant in the trees from the time they left the nursery. Overbearing could certainly have played no part, for the six cases on the southeast side were in a block of 300 Early Rivers which bore only a basket in 1888 and not any in 1889, or at most only here and there a peach. It should also be mentioned that the adjoining Mt. Rose bore a full crop in 1889, but developed no cases.

In 1887 it bore no peaches; in 1888 there were a few peaches on some varieties and none on others. In 1889 there was none on Rivers, a full crop on Mt. Rose and Old Mixon, and a partial crop on other varieties.

The orchard was first selected for a tobacco experiment, but was afterward used for experiments with nitrogen compounds and barnyard manures.

The field is an upland probably 120 feet above the river and in the highest part is at least 20 feet above the marsh. The distance to Sassafras River is about 3 miles. The depth of the nearest well is 16 feet, and the depth of the water in dry weather is about 7 feet. In wet weather in the spring it is nearly full.

The orchard is nearly level, but sags slightly in the center east and west toward the marsh, that part destitute of trees (see map) being low and wet. There is no artificial drainage.

The soil is about 6 inches deep and somewhat variable. Bordering the marsh there is a stony, gravelly slope. The southeast part is a warm, sandy, gravelly flat. The remainder is a loam with occasional gravels. The amount of clay in the soil appears to be slightly greater along the highway and in the northwest corner. The subsoil is a porous yellow clay, which dries in hard lumps.*

The field is less fertile than many on neighboring farms, but with the use of the customary fertilizers it is capable, in good seasons, of 25 bushels of wheat and 50 bushels of maize per acre.

The orchard is bounded as follows: On the north by a level field occupied by apple, pear, and peach orchards;† on the east by a small marsh; on the southeast by a level wheat field; on the southwest by the highway, beyond which is a level wheat field succeeded by other orchards; on the west by a level field occupied by the farm buildings.

The original timber, judging from what remains in the vicinity, was of good quality, consisting of chestnut, locust, black cherry, tulip tree, black walnut, red cedar, sassafras, holly, redbud, persimmon, and similar trees. About one-fourth mile distant on similar soil is a chestnut tree 7 feet in diameter, and sassafras trees 2 and 3 feet in diameter are not wanting in this part of the country.

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*When dry the color of the soil is Ridgway's broccoli brown; when wet, bistre. The color of the dry subsoil approximates Ridgway's wood brown; when wet it is nearly cinnamon color. Both samples were taken on the north side of the orchard about midway east and west.

†The peach orchard is old, and was healthy and productive for many years.

Nothing is known as to the length of time the field has been under cultivation. The forest was probably cut away in the early part of the century, but the village itself is of recent date, and it is possible that the field was cleared more recently.

EXPERIMENT XCII.

Preliminary examination (September 20, 1889).—This experiment deals with a group of six diseased trees on the southeast side of the orchard. They are the ones already referred to as healthy in 1888. They became affected by yellows during the following winter or in the spring or summer of 1889, and with exception of three trees in another part of the field they are the only cases out of an orchard of more than 1,400 trees. The size of the spring foliage is nearly normal, but it is rolled and curled and of that peculiar green, tinged with yellow and red, often seen on diseased trees. The surface is mellow and the soil is a light loam, fertile also, judging by the growth of the trees.

First treatment (September 20, 1889).—The weeds were removed under the branches of each tree in a circle about 12 feet in diameter and 1¼ bushels (44 pounds) of strong tobacco dust was evenly distributed and carefully dug into the soil.

REMARK.—The weeds around the trees were *Ambrosia artemisiæfolia, Erigeron canadensis, Panicum sanguinale,* and trailing blackberry vines.

Second treatment (May 17, 1890).—Each tree received 1½ bushels (36 pounds) of fine, strong tobacco dust, which was put on in the same way as last year and dug into the earth at once. At this date the trees look very well.

First result (October 15, 1890).—None of the trees have recovered but all have made a vigorous growth and are greener than their fellows, having responded to the stimulus of the fertilizer. At the same time the trees bear many diseased shoots and many winter buds are unfolding. One tree is also in blossom. Most of the spring foliage has fallen.

Second result (April 17, 1891).—The tenant removed about one-third of the worst diseased trees this spring, and this included all which had been treated with tobacco.

EXPERIMENT XCIII.

Preliminary examination (April 25, 1891).—This plat is a long, narrow strip on the north side of the orchard, crossing the varieties at right angles and separated from the pear and apple orchard by three untreated rows. It contains two cases of 1890, two suspects, and ninety-three healthy trees, which are of quite uniform growth but still lack some feet of touching. The surface is a level loam, which has not been plowed this spring.

Treatment (April 25, 1891).—This strip received 500 pounds of finely ground dried blood. It was evenly distributed by means of a drill and was plowed down the same day to a depth of 3 to 4 inches.

First result (September 30, 1891).—Two cases, both of which were suspicious, on April 17.

Second result (October 8, 1892).—Twenty-six new cases.

FORTY-NINTH CONTROL.

Preliminary examination (April 25, 1891).—This plat is the one already mentioned as north of XCIII. It contains ninety-nine trees in a rectangle 3 by 33. Three are cases of 1889, two of 1890, two are suspects, and ninety-two are healthy trees similar to those on XCIII. The soil and cultivation are the same.

First result (September 30, 1891).—Three new cases, two of which were suspicious, on April 17.

Second result (October 8, 1892).—Sixteen new cases.

EXPERIMENT XCIV.

Preliminary examination (April 25, 1891).—This plat is separated from XCIII by three untreated rows. The character of the soil, and the size and general appearance of the trees is the same in all this part of the orchard. There are ninety-nine trees in a rectangle 3 by 33. All are healthy with the possible exception of one tree.

Treatment (April 25, 1891).—This strip received 500 pounds of nitrate of soda. It was drilled on and plowed under a few days later before any rain fell.

First result (September 30, 1891).—One case, which was suspicious, April 17.

Second result (October 8, 1892).—Five new cases.

FIFTIETH CONTROL.

Preliminary examination (April 25, 1891).—This strip is between XCIII and XCIV with either of which it is comparable. The soil is level and the trees are of uniform appearance. There are two cases of 1890; one suspect, and ninety-three healthy trees.

First result (September 30, 1891).—There are four new cases, including two doubtful. One of the two not doubtful is the suspect of April 17.

Second result (October 8, 1892).—Five new cases.

EXPERIMENT XCV.

Preliminary examination (April 25, 1891).—This plat is separated from XCIV by three rows forming the fifty-first control. The soil and general appearance of the trees are as on the other plats. There are four vacant places, one suspect, and ninety-four healthy trees.

Treatment (April 25, 1891).—This strip received 500 pounds of sulphate of ammonia. It was drilled on and plowed down at once 3 to 4 inches.

First result (September 30, 1891).—Two cases, one of which is the suspect of April 17.

Second result (October 8, 1892).—Eleven new cases.

FIFTY-FIRST CONTROL.

Preliminary examination (April 29, 1891).—This plat is between XCIV and XCV. It contains 98 trees. The soil is level and the trees are of uniform size. All are healthy.

First result (September 30, 1891).—One case.

Second result (October 8, 1892).—Eight new cases.

REMARK.—September 30, 1891. The three blocks dosed with nitrogen compounds have made an excessive growth. The effect of the blood was quite as marked as that of the nitrate of soda or sulphate of ammonia, and the experiment gave no indication as to any choice in these three forms of nitrogen.

EXPERIMENT XCVI.

Preliminary examination (April 29, 1891).—This plat is in the northeast part of the orchard and consists of seventeen trees in one north and south row. All are healthy, with exception possibly of one tree, and with the exception of one replant they are of uniform size. The soil is level and of uniform appearance, except on the extreme south end, where it changes character on the crest of the knoll and becomes somewhat stony.

Treatment (*April 29, 1891*).—This row received nine big two-horse loads (side boards up) of half-rotted hay and sheep manure. The one small replant was given only a little, so that the sixteen big trees received over one-half load each. This manure was made during the previous winter under a feeding shed protected from rain. It was tramped solid and was presumably rich in plant foods.

It was spread copiously over the whole surface to a distance of 9 feet each side of the row, and the earth was plowed the same day to a depth of 4 to 5 inches. Nearly all of it was turned under, but slowly and with difficulty, owing to the quantity. A jointer was used and the furrows were turned toward the row.

First result (*September 30, 1891*).—One case. This tree was marked suspicious as early as April 17, and was still more questionable on April 25. It was probably diseased before the treatment began.

REMARK.—The two controls were plowed a few days later.

Second result (*October 8, 1892*).—Four new cases.

FIFTY-SECOND CONTROL.

Preliminary examination (*April 29, 1891*).—This plat consists of seventeen trees in one row west of XCVI. The soil is the same and the trees are of the same variety (Rivers) and of the same general appearance.

First result (*September 30, 1891*).—No cases.

Second result (*October 8, 1892*).—Three cases.

Experiment XCVII.

Preliminary examination (*April 29, 1891*).—This plat consists of seventeen healthy trees in one row, next west of the fifty-second control. The soil is the same and the trees are of uniform size.

Treatment (*April 29, 1891*).—Each tree received three-quarters of an ordinary two-horse load of composted manure. This was moist, black, well rotted and fine. It consisted originally of hay, straw, and cornstalks mixed with droppings of horses and sheep. It was hauled from the barnyard in the summer of 1890 and worked over into a big pile in the open field, where it has remained exposed to the weather. It looks rich, but it probably lost much of its value during the heavy rains of January, February, and March. This compost was spread around each tree to a depth of 2 to 3 inches, in a circle having a radius of about 8 feet. It was plowed down the same day to a depth of 3 to 4 inches, the furrows being turned toward the row.

First result (*September 30, 1891*).—No cases.

Second result (*October 8, 1892*).—Six cases, one of which appeared after July 12.

FIFTY-THIRD CONTROL.

Preliminary examination (*April 29, 1891*).—This row is next west of XCVII. It contains seventeen trees of the same variety (Rivers). All are healthy and of uniform size. The soil is the same, *i. e.*, level and of quite uniform composition, except that at the south end one tree is on a gravelly slope.

First result (*September 30, 1891*).—One case.

Second result (*October 8, 1892*).—No new cases.

FIFTY-FOURTH CONTROL.

Preliminary examination (*April 29, 1891*).—This plat may be compared with the next experiment. It consists of nineteen trees in one north and south row extending from the highway to the plat treated with $(NH_4)_2SO_4$ (see Plate XXX).

First result (*September 30, 1891*).—No cases.

Second result (*October 8, 1892*).—Three cases.

EXPERIMENT XCVIII.

Preliminary examination (April 29, 1891).—This plat consists of eighteen trees in one north and south row west of the fifty-fourth control. All are healthy and of quite uniform size.

Treatment (April 29, 1891).—Each tree received one-half of a big two-horse load of barnyard manure. This was made in the winter of 1890-'91 in the open yard, and consisted of wet, trodden, and decomposing hay, straw, cornstalks, urine, and cow dung. It was spread as thick as would turn under, 9 feet each side of the tree row. It was plowed down the next morning.

First result (September 30, 1891).—No cases.

Second result (October 8, 1892).—One case.

FIFTY-FIFTH CONTROL.

Preliminary examination (April 29, 1891).—This row consists of seventeen trees next west of XCVIII. They are of uniform size and all are healthy.

First result (September 30, 1891).—No cases.

Second result (October 8, 1892)—No cases.

EXPERIMENT XCIX.

Preliminary examination (April 29, 1891).—This plat consists of sixteen trees, originally seventeen, in one row west of the fifty-fifth control. All are of uniform size and are healthy, but one case of 1890 was dug out this spring.

Treatment (April 29, 1891).—The south half of this row received the same kind of treatment as XCVIII. The rest received wetter and more thoroughly rotted straw, etc., from under an open shed. This, however, was probably least rich in potash, phosphoric acid, and nitrogen. As on XCVIII, the manure was spread evenly over a strip 18 feet wide, and plowed down the next morning. Each tree received five-eighths of a big two-horse load, *i. e.*, a greater quantity than XCVIII.

First result (September 30, 1891).—No new cases.

Second result (October 8, 1892).—Three cases.

FIFTY-SIXTH CONTROL.

Preliminary examination (April 29, 1891).—This plat consists of one row of sixteen trees west of XCIX. All are healthy, except possibly two, which have become suspicious since 1890. The trees are of the same size and general appearance, and even the suspects are good looking trees, not likely to attract attention or cause suspicion.

REMARK.—The trees in these five rows are of very uniform size and somewhat larger than those to the east or west. The soil is of nearly uniform appearance and nearly level, sagging a little in the center toward the east, and slightly moister.

First result (September 30, 1891).—The only cases are the two trees suspected in the spring.

Second result (October 8, 1892).—Three cases.

GENERAL REMARKS.

1890: *May 17.*—The black aphis is abundant on the parts above ground.

October 15.—Forty-one cases, *i. e.*, nearly 5 times as many as last year. The orchard bore no fruit. It was plowed and cultivated as usual.

1891: *April 17.*—Orchard in full blossom and very showy. Examined for new cases.

April 25.—The soil is rather hard and dry and rains are needed. The foliage is about as far advanced as in the Maxwell orchard (Plate VI), and here and there a peach begins to burst its cap.

September 30.—The whole field was plowed and harrowed soon after the conclusion of the treatments. The orchard yielded an enormous crop. All varieties bore heavily, but a large part rotted, especially on the nitrated plats. The trees are considerably broken by the weight of foliage and fruit, especially those which received nitrogen. This treatment was an injury. The nitrated trees have shed much foliage and are not as green as they were. They have stood out from the controls all summer very distinctly, appearing in July to have twice as much wood and foliage.

The effect of the manure is also visible. The trees on XCVI and XCVII have made most growth and their foliage is more abundant and darker green than on the controls, but the growth has not been excessive or very remarkable, as on the plats dosed solely with nitrogen. The weeds under the manured trees have grown amazingly, and the same is true of the spots dosed with tobacco last year. Each bears a dense rank growth. At this date there is nothing specially noteworthy in the appearance of XCVIII and XCIX, and it is difficult to distinguish them from the three controls. Mr. Wilmer Ford, the tenant, states that the peaches on the nitrated plats were inferior and were retarded in their development more than a week, while, contrary to his expectation, they were superior on XCVIII and XCIX. The effect, if any, on the fruit borne by XCVI and XCVII escaped his attention. There are 89 new cases of yellows, but they are confined principally to the southeast part of the orchard, which was not treated. About one-third of these cases were suspicious on April 17. The distribution of cases has not followed varieties, *e. g.*, the south half of Early Rivers and Mountain Rose have developed many more cases than the north half.

1892: *July 12.*—The trees have been properly cultivated and have made a good growth. The trees which were dunged are still greener than their fellows. No decided extra greenness in the foliage of the trees which received the nitrogen compounds last year.

The most common weed in the orchard is *Commelyna virginica.*

October 8.—The effect of the manure put on plats XCVI and XCVII is still plainly visible in the foliage. There is also more foliage on the south end of XCIX than on the controls. Nothing noticeable on XCVIII. The three blocks which received commercial nitrogen compounds are not distinguishable from the controls. Some varieties have shed all or nearly all of their foliage; others retain about one-fourth. The wood is well ripened. The first hard frost was October 6. As in other orchards examined this week, the symptoms are slight, owing, apparently, to the very dry autumn. The roads are dryer and dustier than in five years. The orchard is covered with low grass and weeds.

It bore no fruit this year, *i. e.*, only one basket of Rivers and two of Amsden, and yet there is a great increase of cases, nearly three times as many as last year.

The following table gives the cases and per cents by years:

TABLE XXX.—*Showing progress of yellows on 1,443 trees in the orchard of J. Frank Wilson, Still Pond, Md.*

Year.	Cases.	Per cent.
1887	0	0
1888	0	0
1889	9	0.6
1890	42	2.9
1891	89	6.2
1892	230	15.9
Total	370	25.6

There are not enough cases on the treated plats or controls to make comparisons necessary or to give the experiments anything but a negative value. But this they certainly have. Evidently, judging by the results in 1891, something more than the presence of yellows in a neighborhood and the application of an excess of nitrogen is necessary to induce the disease. For, if excess of nitrogen favors yellows, why should the disease have picked out the very spots not treated and not suffering from any superabundance of this element. In 1892 Plat XCIII developed many cases, but the companion plats XCIV and XCV, which made an equal overgrowth in 1891, suffered comparatively little.

SERIES XII.—ORCHARD OF WILLIAM O. SHALLCROSS, LOCUST GROVE, MD. (PLATE XXXI.)

This orchard is north of Locust Grove, on high land, about 1 mile from Sassafras River, and some miles east of the Harper orchard (Series IX) in upper Kent. It is about midway of the farm, on the east side of the highway. The orchard contained about 19 acres, but the back part was so badly dwarfed and diseased by yellows in 1889 that it was not considered worth while to make any experiments on it. The front portion of the field, here considered, contains about 11 acres.

The west 700 trees, next the highway, came from western New York, the rest, including those on the back 8 acres, came from the neighborhood.* The trees were set in the spring of 1887, at a distance apart of 20 by 20 feet. The number set on the part selected for experiment amounted to 1,096, the place of seventy-two trees in the northeast corner (see map) being occupied by young apple trees set in to fill out. The total trees at the commencement of the experiments was 1,041, the die-outs being attributable to the black root-aphis and other causes than yellows. The west four rows bordering the highway did not amount to much, being dwarfs or replants. About thirty trees were suspicious or plainly diseased by yellows (cases of 1889). The remainder were healthy and thrifty.

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* Mr. S. said that the home trees began to show symptoms of disease almost as soon as set. There were seventy-five cases on the back 8 acres in 1889, and more had died and disappeared prior to that year.

The first cases of yellows, so far as that part of the orchard now in question is concerned, appeared in 1889.

The orchard was selected as specially suited to treatment for the following reasons:

(1) It is in a region where yellows appeared as early as 1875, and has been very destructive, but which is in other respects well adapted to the peach, and where the orchards were formerly very extensive and profitable.

(2) The disease was still so prevalent that not a single entirely healthy orchard of bearing age could be found in the vicinity, while many young orchards not in bearing began to be seriously affected.

(3) The orchard across the road* had become diseased from end to end and been dug out within a period of six years, while about two-thirds of the trees in a younger one, the nearest on the next farm south, had become diseased in a space of three years.

(4) Another peach orchard had grown on the same soil for 14 years and was dug out in 1875, at which time there were some cases of yellows in it.

(5) The soil is nearly uniform.

(6) The trees, except as already stated, were of quite uniform growth and good appearance.

(7) The disease had already begun in a small way, and if the remainder of the trees could be kept healthy, even for a few years, the object lesson would be very striking, and the prospect of success in other less affected localities would be good.

The orchard included a number of common varieties of white and yellow fruit, Troths, Rivers, Old Mixon, Crawfords, etc. It bore no fruit in 1887, none in 1888, and none in 1889.

The orchard was cultivated in corn in 1887; in tomatoes and potatoes in 1888, and in tomatoes in 1889. The trees were pruned in the ordinary manner, and well cultivated and cared for by the owner, but not heavily fertilized.

The surface is nearly level, but there is a slight rise on the back end and a shallow depression in the northeast corner. There is no artificial drainage, and water never stands, the subsoil being a porous yellow clay.

The orchard is bounded on the north by a level field used for wheat, asparagus, and gooseberries; on the east by a continuation of the same orchard, nearly level for many rods, and then sloping into a forest; on the south by a level wheat field; on the west by the highway, beyond which is a level clover field of good appearance, formerly occupied by the diseased orchard already mentioned.

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* No. 7 of Bull. No. 9.

The elevation above Sassafras River is probably 120 feet. The depth of the nearest wells is 60 feet, and the depth of the water in them is generally about 6 feet.

The soil is a light yellowish loam inclined to be gravelly in places, especially on the higher, east part, and to bake after protracted rains. It is warmer land and less fertile than that occupied by the Harper orchard (Series IX).

Many fields in this immediate neighborhood are less fertile than they were, and Mr. S. once said that he was thankful to get 20 bushels of wheat per acre. It is not barren soil, however, for one of the finest apple orchards in the county is on this farm, and many other crops are grown profitably.

The timber in the neighborhood is much like that already mentioned in speaking of the Maxwell and Harper orchards, *i. e.*, a good quality of chestnut, black cherry, etc. This was one of the earliest settled parts of the upper bay shore and the field has probably been cleared of forest and under cultivation one hundred and fifty years, more plant food having been removed from the soil than has been put back. Mr. Shallcross's own methods were those of a good farmer.

The front 11 acres of this orchard was divided into eight narrow plats extending east and west the whole length of the field. Four ot these were held for comparison, and the alternating four were treated in duplicate, only two mixtures being used. The four strips selected for treatment were plowed and harrowed October 29, 1889.

EXPERIMENT C.

Preliminary examination (*October 30, 1889*).—This plat is on the north side of the orchard. It is four rows wide, and contains eight vacant places, one doubtful tree, six cases of yellows, and 147 healthy trees. There are also twenty-one small apple trees on the east end, alternating with peach trees.

First treatment (*October 30, 1889*).—Dissolved bone black was drilled in at the rate of 3 pounds per tree, and muriate of potash was broadcasted at the rate of 2 pounds per tree. The strip was harrowed the next day. Immediate results were desired, and therefore only about one-third of the whole surface was covered, *i. e.*, that most drawn upon by the roots.

Second treatment (*May 5, 1890*).—Each tree received 5 pounds of the following mixture:

Dissolved bone black (16 to 18 per cent soluble and available P_2O_5), 528 pounds; muriate of potash (50 per cent K_2O), 352 pounds.

The mixture was weighed out and sowed by hand, from one-half to two-thirds of the whole surface being covered, *i. e.*, that part most drawn upon by the roots.

First result (*October 3, 1890*).—There are eighteen new cases. None of the old ones have recovered, and the tree which was doubtful now shows distinct symptoms, and ought probably to be included with the cases of 1889. All of the healthy trees are very thrifty and still full of active green leaves. Two healthy trees are gone, broken off or blown down, probably. The appearance of an average healthy tree and of a case of 1889 are shown on Plate XVIII.

Third treatment (*April 20, 1891*).—Each tree was given 5 pounds of a mixture consisting of 3 pounds of best dissolved bone black and 2 pounds of muriate of potash. This was distributed evenly in a circle under the branches, about one-quarter only of the whole surface being covered. The soil is moist but not wet.

REMARK.—The treated plats were harrowed next day and the whole field was plowed on May 7–9.

Second result (*October 1, 1891*).—Including four doubtful trees there are thirty-two new cases. All of the old cases are worse than last year.

Third result (*July 15, 1892*).—All of the trees were removed in the spring and the plat planted to corn.

FIFTY-SEVENTH CONTROL.

Preliminary examination (*October 30, 1889*).—This plat joins C on the south. It is three rows wide and forty-seven long. The rectangle contains four vacant places, nine diseased trees and 110 healthy trees. On the back end there are also seventeen young apple trees, alternating with the peach. The soil and general appearance of the trees are the same as on Plats C and CI.

First result (*October 3, 1890*).—Fourteen new cases, including one doubtful. None of the old cases have recovered. The healthy trees are thrifty and still bear much green foliage.

Second result (*October 1, 1891*).—Thirty-two new cases. None of the old ones have recovered, but they are not worse than those on the adjoining treated plats. The doubtful tree is now plainly diseased. The healthy trees are handsome.

Third result (*October 7, 1892*).—One-half of the block was pulled out in the spring. Twenty-one new cases on the remainder.

EXPERIMENT CI.

Preliminary examination (*October 30, 1889*).—This plat is next south of the fifty-seventh control. It contains three cases of yellows, eight vacant places, and 114 healthy trees. There are also sixteen young apple trees on the back end, alternating with the peach trees.

First treatment (*October 30, 1889*).—A duplicate of Plat C.

Second treatment (*May 5, 1890*).—A duplicate of C.

First result (*October 3, 1890*).—Twenty-four new cases, including three doubtful. The old cases have not recovered. The healthy trees are very thrifty and full of active green foliage.

Third treatment (*April 20, 1891*).—A duplicate of Plat C. April 23 each tree was also given one-fourth bushel of freshly slaked caustic lime. This was sowed in circles from the trunks outward, so as to cover about three-fourths of the whole surface. It fell upon unplowed but recently harrowed soil, and there was a shower that night. The field was plowed May 7–9.

Second result (*October 1, 1891*).—Twenty-eight new cases, and the old ones are worse than last year and a very hopeless lot. The doubtfuls are now plain cases. The lime was of no benefit.

Third result (*October 7, 1892*).—One-half of the block was pulled out in the spring. Eighteen new cases on the remainder.

FIFTY-EIGHTH CONTROL.

Preliminary examination (*October 30, 1889*).—This plat is next south of CI. Like all the other plats except C it is a rectangle 3 by 47. There are six vacant places, one case of yellows, and 117 healthy trees. On the back end, alternating with the peach trees, are seventeen young apple trees. The soil and general appearance of the trees are the same as on the other strips.

First result (*October 3, 1890*).—Including four doubtful trees there are twelve new cases. The healthy trees are thrifty and still covered with active green leaves.

Second result (*October 1, 1891*).—Twenty-four new cases, and none of the old ones have recovered. The doubtful trees are also now plain cases.

Third result (*October 7, 1892*).—One-half of the block was dug out in the spring. Twenty-eight new cases on the remainder.

EXPERIMENT CII.

Preliminary examination (*October 30, 1889*).—This strip is next south of the fifty-eighth control and of the same size. It contains seven vacant places, two cases of yellows, and 132 healthy trees. It is comparable with the controls at either side.

First treatment (*October 30, 1889*).—This strip received 423 pounds of best dissolved bone black and 282 pounds of nitrate of potash. They were weighed out for each tree, sowed separately, and harrowed in the next day. About one-third of the whole surface was covered, *i. e.*, that nearest to the trees.

Second treatment (*May 5, 1890*).—Each tree received 3 pounds of dissolved bone black (16 to 18 per cent of soluble and available P_2O_5) which was distributed in a circle around each tree out to somewhat beyond the spread of the branches, from one-third to one-half of the whole surface being covered. Rain for one-half day followed. May 6, 2 pounds of nitrate of potash were sowed around each tree, from one-half to two-thirds of the surface being covered, *i. e.*, the parts most drawn on by the roots. The soil is now very wet. The fertilizer fell upon plowed earth, which was harrowed as soon as the field was dry enough.

First result (*October 3, 1890*).—The old cases have not recovered, and there are seventeen new cases, including one doubtful. Two healthy trees are gone, probably broken down by a wind. The appearances of an average healthy tree, Fig. 1, and of a case of this year, Fig. 2, are shown on Plate XIX.

Third treatment (*April 20, 1891*).—Each tree received 5 pounds of the following mixture:

	Pounds.
Dissolved bone black (16 to 18 per cent soluble and available P_2O_5	3
Nitrate of potash (12 per cent N)	2

This was sowed evenly under the branches, so that about one-fourth of the whole surface was covered. The fertilizer did not hold out, and the last two trees on the east end of the south row received nothing. The plat was harrowed April 21, and plowed between May 7 and 9.

Second result (*October 1, 1891*).—There are forty-one new cases, including one doubtful. All of the old cases are worse than last year, although most of them have responded to the fertilizers distinctly. The doubtful case now shows distinct symptoms.

Third result (*October 7, 1892*).—One-half of the block was pulled out in the spring. Eighteen new cases on the remainder.

FIFTY-NINTH CONTROL.

Preliminary examination (*October 30, 1889*).—This plat contains three vacant places, 3 cases of yellows, and 135 healthy trees. The trees are in a rectangle 3 by 47, separating Plats CII and CIII, with the trees on either of which they are comparable.

First result (*October 3, 1890*).—Including 6 doubtful trees there are 25 new cases.

Second result (*October 1, 1891*).—Thirty-two new cases. None of the old ones have recovered, but they are not worse than on CII or CIII. The cases which were doubtful also show distinct symptoms.

Third result (*October 7, 1892*).—One-half of the block was dug out in the spring. Thirteen new cases on the remainder.

EXPERIMENT CIII.

Preliminary examination (*October 30, 1889*).—This plat is also three rows wide. It contains ten vacant places, 3 cases of yellows, 2 suspects, and 126 healthy trees.

First treatment (*October 30, 1889*).—A duplicate of CII.

Second treatment (*May 6, 1890*).—A duplicate of CII.

First result (*October 3, 1890*).—One of the suspects is dead and the other is still doubtful. The old cases have not recovered, and there are twenty-seven new cases, including five doubtfuls. The remainder are full of active foliage and very thrifty.

Third treatment (*April 20, 1891*).—A duplicate of CII. The fertilizer did not hold out and the east tree of the north row received no treatment. April 23 this plat was limed in the same manner as CI, and plowed between May 7 and 9.

Second result (*October 1, 1891*).—Thirty-one new cases. All of the old cases are worse than last year. The doubtfuls are also now plain cases. The lime did not exert any noticeable influence.

Third result (*October 7, 1892*).—One-half of the block was dug out in the spring. Twenty-four new cases on the remainder.

SIXTIETH CONTROL.

Preliminary examination (*October 30, 1889*).—This plat is south of CIII and includes the outermost three rows. Some of the trees are rather small, particularly in the middle and towards the east end. There are nine vacant places, 3 cases of yellows, and 129 healthy trees.

First result (*October 3, 1890*).—Including one doubtful there are 13 new cases. Two healthy trees have died and one is gone. The rest look fairly well, but are decidedly less green and thrifty than on the other plats.

Second result (*October 1, 1891*).—Twenty new cases. None of the old have recovered.

Third result (*October 7, 1892*).—One-half of the block was removed in the spring. Nineteen new cases on the remainder.

EXPERIMENT CIV.

Preliminary examination (*April 23, 1891*).—This experiment consists of a single tree on the Fifty-ninth control. It contracted yellows in 1890, having previously made a good growth. At this date it appears to be as well suited for a curative treatment as any in the orchard.

Treatment (*April 23, 1891*).—This tree was dosed very heavily with quicklime. The earth was first removed from around the trunk over a diameter of 3 feet and to a depth of about 3 inches. Then one and one-half bushels of caustic lime was poured into this cavity and covered over with earth. One bushel of lime was also sowed on the surface, beginning 18 inches from the trunk and spreading out 18 inches farther. This limed the soil very thoroughly over a radius of fully 3 feet, and perhaps a little more. The whole was plowed down May 7 to 9.

Result (*October 1, 1891*).—Owing to the lime treatment it was much greener and more vigorous in spring and early summer than any other diseased tree in the orchard, but now it is worse than any diseased tree near it and does not look as though it had ever had any special stimulus. This tree is a miserable, sickly specimen. Most of the spring foliage has fallen and what remains shows evidence of disease. The tree is affected in all parts and winter buds are unfolding on the branches of every main limb. It also bore premature fruit, which rotted and still clings.*

GENERAL REMARKS.

1889: The treatment was preceded and followed by much rainy weather. The entire month of November was very rainy. The control strips received no autumnal plowing.

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*This tree died the following spring after sending out a few feeble sprouts. In 1888, in another orchard, gas lime was tried on 13 trees in ½-bushel doses, dug into the earth. The trees became more vigorous for a few months under the stimulus, but received no permanent benefit.

1890: *May 5.*—The orchard was plowed and harrowed about a week ago, and is now in a clean, satisfactory condition. With a few exceptions, the trees look well. There are no peaches. If all that have set mature there will not be three baskets in the whole orchard. The mild winter and the spring frosts destroyed all of the peaches in this region.

May 6.—A continuous rain of one half day made the ground very wet, but it was not violent and did not flood or wash any part of the orchard.

October 4.—The orchard was harrowed soon after May 6 and again (?) later. It was replowed after harvest, a heavy growth of grass and weeds being turned under. Possibly this may account for the unexpected and unusual late growth and greenness of Plats C and CI, on which no nitrogen was put (see Fig. 1, Plate XVIII), and of all the controls except No. 60. The orchard is now nearly free from weeds. Popcorn was grown on the west end of Plat C, including twelve to fourteen tree-rows, but does not seem to have made any difference in results.

There was no fruit this year, *i. e.*, not over a dozen peaches on the entire 11 acres, and yet there was a large increase of cases.

1891: *April 16.*—Many new cases have appeared since October last. Troths and Early Rivers are in blossom; other varieties will bloom in a few days. All of the trees on the east 8 acres have been pulled out, except a few in the northeast corner. They were a sickly lot.

April 20.—The orchard has done blossoming, nearly, except one variety.

May 19.—The orchard was plowed May 7 to 9 and "wormed." Some of the trees have been quite seriously injured by borers, judging from the amount of bark destroyed, since they do not show injury in growth or foliage. This orchard and Series I are the only ones in which borers have played any conspicuous part, and it does not appear that the yellows was limited to infested trees or showed any special preference for them.

October 1.—The orchard has not been cultivated since June, and is very grassy and weedy. The weeds are tallest and most abundant on the treated plats, and the white pigweed (*Chenopodium album*) is especially conspicuous on the nitrated plats. There are many sorts of weeds in this orchard, *e. g.*, *Malva rotundifolia*, *Verbascum thapsus*, *Lepidium virginicum*, *Asclepias cornuti*, *Aster*—, *Chenopodium album*, *Amarantus albus*, *A.*—, *Mollugo verticillata*, *Abutilon avicennæ*, *Portulacca oleracea*, *Cnicus lanceolatus*, *Erigeron canadensis*, *E. annuus*, *Phytolacca decandra*, *Verbena urticifolia*, *Plantago rugelii*, *P. lanceolata*, *Ambrosia artemisiæfolia*, *Rumex*—, *Polygonum*—, *Solanum nigrum*, *Bidens frondosa*, *B. bipinnata*, *Cuphea viscosissima*, *Setaria viridis*, *S. glauca*, *Panicium sanguinale*, *P. capillare*, *Eragrostis*—, *Specularia perfoliata*, *Silene antirrhina*, *Ipomœa nil*, *Rubus canadensis*, *Œnothera biennis*, *Daucus carota*, *Oxalis stricta*, *Cyperus*—, *Allium vineale*, *Anagallis arvensis*, *Muscari botryoides*, *Trifolium pratense*, *T. repens*, *T. arvense*.

There is not now a great deal of difference in the appearance of the treated and untreated rows, but on the nitrated blocks the leaves are a little greener. For two years the evidence has gone to show that there is no lack of nitrogen in the soil, the contrast between nitrated and non-nitrated plats not having been as great as was expected from results in other orchards. Contrast Figs. 1 of Plates XVIII and XIX. The trees do not yet occupy the entire ground; in fact, the branches lack 5 to 10 feet of touching those of neighboring rows.

Occasionally a tree which has been diseased for several years and once showed distinct symptoms is now simply stunted, with reddish and yellowish foliage, but no branching sprouts or unfolding winter buds. They are miserable specimens, and probably bore premature fruit, but if they had not been seen earlier no one could say unqualifiedly that they were affected by yellows. In a few instances the trees are not stunted, and there are no sprouts or unfolding winter buds, but the foliage is yellowish and reddish and unnaturally curled, just as in many genuine cases not of long standing. In such cases diagnosis is doubtful, and the only way to settle the matter is to give the orchard the benefit of the doubt by removing the tree on suspicion, or else to make a number of examinations. For example, two look exactly alike, except that one bears a few diseased sprouts and unfolding winter buds, while the other does not. The spring foliage of both is abundant and full grown, but much of it is unnatural in color and in curve. A little experience readily enables one to pick out such trees, but it is rather difficult to describe them so that they will not be confounded with diseased trees not suffering from yellows.

The orchard bore a large crop of fruit, but most of it prematured or rotted. Only about 150 baskets were shipped, but this was because prices ruled so low that freight and commissions amounted to more than the selling price.

There are many new cases, about two-fifths of which showed symptoms of disease as early as April 16.

1892: *July 15.*—The north four rows, the west five rows, and a large part of the middle of the orchard were removed in the spring and planted to corn and tomatoes. The rows which were left looked so worthless in the spring that only a few furrows were turned to each side of them, the middles being left unplowed. The orchard is full of tall weeds. No difference this year any more than last in favor of the treatment. There are many new cases, and the old cases are much worse than last year. The trees bore no fruit.

October 7.—Mr. Robert Shallcross says that the tomatoes on the treated plats remained green through the whole season, while those on the controls became yellow. The amaranths in this field are numerous and tall, 5 or 6 feet.

These treatments attracted a good deal of attention, and the orchard has had many visitors during the past three years who can bear witness to the vigorous growth and fine appearance of the trees previous to their attack.

SUMMARY.

The cases and per cents, by years, in this orchard are as follows:

TABLE XXXI.—*Showing progress of peach yellows in the orchard of William O. Shallcross, Locust Grove, Md.*

[Originally 1,096 trees, but only 1,041 in spring of 1889.]

Year.	Cases.	Per cent.
1887	0	0
1888	0	0
1889	30	2.9
1890	150	14.4
1891	240	23.1
Total	420	40.4

A comparison of treated and untreated plats will be found in the following tables:

TABLE XXXII.—*Showing number of healthy trees in the spring of 1889, and cases, by years, on treated and untreated plats in the orchard of William O. Shallcross, Locust Grove, Md.*

Plat.	Healthy trees.	1889.	1890.	1891.	Total cases.
C	154	6	18	32	56
57	119	9	14	32	55
CI	117	3	24	28	55
58	118	1	12	24	37
CII	134	2	17	41	60
59	138	3	25	32	60
CIII	129	3	27	31	61
60	132	3	13	20	36

TABLE XXXIII.—*Showing per cent of cases by years, on each plat in the Shallcross orchard, prior to treatment and afterward.*

Year.	Per cents, by plats, etc.													
	C.	57.	CI.	58.	CII.	59.	CIII.	60.	C and CI.*	57 and 58.	CII and CIII.†	59 and 60.	Total treated.	Total untreated.
1889	3.9	7.6	2.6	0.8	1.5	2.2	2.3	2.3	3.3	4.2	1.9	2.2	2.6	3.1
1899	11.7	11.8	20.5	10.2	12.7	18.1	20.9	9.8	15.5	11.0	16.7	14.1	**16.1**	**10.7**
1891	20.8	26.9	23.9	20.3	30.6	23.2	24.0	15.2	22.1	23.6	27.4	19.3	**24.7**	**21.3**
Total	36.4	46.3	47.0	31.3	44.8	43.5	47.2	27.3	40.9	38.8	46.0	35.6	**43.4**	**35.1**

* Incomplete fertilizer.
† Complete fertilizer.

From these tables, especially the last, it will be seen (1) that the per cent of cases has been slightly more on the treated than on the untreated plats and (2) that the two plats which received the complete fertilizer are slightly worse off than the two which received the incomplete fertilizer. These results by themselves, however, are not sufficiently pronounced to be of much value, but possibly, when taken in connection with the results in some of the other orchards, they may be of use. Two other facts stand out, viz (1) the three rows on the south side, which made the least growth and looked the least desirable (sixtieth control), developed fewest cases and (2) the fertilizers did not exert the least curative or restoring influence. The disease, as in the other orchards, appears to have made the same progress that it would have made without treatment. No other inference can be drawn from a comparison of the treated and untreated plats.

The results in 1892 are not included in the tables, because over one-half of the trees were removed in the spring. On the remainder there were 231 healthy trees, 141 of which became diseased without reference to treatment. Only 90 healthy trees remain, and it is almost certain that on the whole 10 acres not more than 200 healthy trees would have been present at the close of 1892. This means that in seven years from time of planting and five years from the first appearance of the disease the entire orchard would have succumbed.

SERIES XIII.—ORCHARD OF GEORGE GILDERSLEVE, RISING SUN, DEL. (G. D. Jackson, tenant.)

This large and thrifty orchard is one-half mile north of Series III and the soil is similar. The trees, now 8 years old, have made an excellent growth and the limbs and branches are smooth and handsome. The entire orchard has always been productive, the fruit being of superior quality.

In the level southwest corner of this orchard, bordering the two highways, twenty-three trees, diseased by yellows, were selected for treatment with tobacco. The soil is a light loam of good quality and the cultivation has always been thorough and careful.

From this corner of the orchard about thirty trees have been removed on account of yellows, and nearly one-third of the remainder (61 out of 217) are now diseased (cases of 1888 and 1889).

EXPERIMENT CV.

Preliminary examination (*September 2, 1889*).—These trees may be divided into three classes: (1) those only slightly affected; (2) those diseased in nearly all parts, but still bearing green foliage; (3) those diseased in all parts and bearing yellow and sickly looking foliage. Class 3 was considered past all hope. Classes 1 and 2 were selected for treatment, seventeen of the former and six of the latter.

First treatment (*September 2, 1889*).—About 46 pounds of tobacco dust was sowed evenly under each tree top as far out as the branches spread, a considerable amount being put close to the trunk. This was at once dug into the earth.

REMARKS.—The dust was strong and very free from dirt. Each tree was carefully examined for borers, but only one was found, and most of the trees were free from injury. The yellow ant, *Lasius claviger*, was common in the soil about the trunks, and there were a few black aphides on the roots. The red-bordered leaf spot, supposed to be due to the shot-hole fungus, *Cercospora circumscissa*, was common on the foliage, especially of the lower limbs.

Second treatment (*May 21, 1890*).—Each tree received 1¾ bushels (about 45 pounds) of strong, clean tobacco dust. This was put on over a radius of about 5 feet and dug into the earth at once, much being put near the trunks.

REMARK.—It is, perhaps, too early to speak positively, but there seem to be many new cases this spring. In this corner of the orchard at least thirty trees which showed no trace of disease last September now look very suspicious.

First result (*September 19, 1890*).—The trees have felt the stimulus of the fertilizer, but there are no recoveries. The condition of the trees of class 1 is as follows:

(1, 3) These two trees are worse than last year and now bear diseased shoots on every limb of any size. Each tree bears dozens of them, and hundreds of winter buds are now unfolding or have opened recently. The foliage is still green.

(4, 5) An abundance of spring foliage of good color and normal size, but there are rampant, diseased shoots on parts of all the main limbs, and some limbs are affected throughout.

(7) Miserable, much-branched, badly affected shoots on the trunk near the earth; rampant, diseased growths on the base of the main limbs; two big limbs diseased in all parts, even to the very end twigs. Much full-grown, good, green foliage on the other limbs, but these also bear some diseased shoots, even on the topmost twigs.

(8) Bears more than 100 diseased shoots. There are diseased growths from the base of all the main limbs, and four good-sized limbs are badly diseased in all parts. There is much full-grown, good-looking foliage on the rest of the tree.

(9) There is an abundant growth of diseased shoots from the base of the main limbs. Three large limbs bear dozens of sickly shoots and are badly diseased throughout. There is much good foliage on the rest of the tree.

(12) There are diseased shoots on all but one main limb and two big limbs are badly affected throughout. The tree still bears much good foliage.

(13) The tree bears an abundance of good leaves, but the trunk has become a thicket of diseased shoots, and four limbs are affected to the very extremities.

(16) The tree bears considerable good-looking, green, vigorous foliage, but there are plain symptoms of disease in nearly all parts, and several limbs bear a great number of diseased shoots distributed all the way from the base to the topmost branches.

(17, 18, 19.) Like 16.

(20) One limb is badly diseased throughout and there are a few sickly sprouts on two other large limbs. There is much good foliage. This is the best tree.

(21) This tree bears more than 150 diseased shoots and two limbs (each 2 to 3 inches in diameter at the base) are diseased in all parts. As on most of the other trees, there is still much healthy foliage.

(22, 23) Dug out some weeks ago by the tenant, who says they were badly diseased.

The trees of class two are still worse and an individual account is unnecessary.

REMARK.—All of the thirty trees which were healthy in the autumn of 1889 and suspicions in the spring of 1890, are now badly diseased by yellows. They were either affected prior to September 2, without symptoms, or contracted the disease between that date and May 21. The winter was like a long autumn.

Second result (*August 27, 1891*).—The results were so unsatisfactory that all of the trees except three of the best-looking ones were removed in the winter of 1890–'91. These three were examined several times during the spring and summer, but became still further diseased and were finally dug out.

GENERAL REMARKS.

The results of this experiment agree closely with those obtained in several other orchards. Tobacco in quantity stimulates the trees to make an increased growth, but it has no curative qualities.

SERIES XIV.—ORCHARD OF JAMES ALEX. FULTON, DOVER, DEL

(Plate XXXII.)

This orchard is on the west side of Queen street, in the north part of Dover, near the glass factory. The trees were grown by Mr. Fulton with pits from Tennessee and buds from Kent County, Del. They were set in the spring of 1887. The rows are 40 feet apart and the trees in each row are 20 feet apart. The total trees set amounted to 93.

Sixteen died from transplanting or accidents of culture, 5 being replaced by peach and part of the remainder by cherry trees, which have grown thriftily.

The trees were examined in August, 1888, and noted as being very thrifty. Their appearance in 1889 was also that of a healthy and vigorous orchard, and there was only one case of yellows; but in an older orchard, some rods west of this, in the same field and on similar soil, there were many cases. These older trees were set in 1882, 40 by 40 feet apart, generally with a plum or cherry tree alternating in the rows one way. Yellows probably appeared as early as 1886, for there were a number of well-defined cases in the summer of 1887. In September, 1889, this orchard contained 134 healthy trees, 60 bad cases of yellows, and 46 vacant places from many of which diseased trees had been removed. In 1887 and 1888 (?) the two orchards were cultivated without crops. In 1889 maize was grown between the rows of both orchards, and that between the younger trees was tallest and best eared.

The orchard consists of several varieties of white and yellow fruit, Hales Early, Smock, etc., but has never borne any peaches. It has been pruned in the ordinary manner, but the distance from the ground to the first branches is greater than in most orchards.

This orchard is about 1 mile from Series I, and about the same distance or a little more from Series II. The soil is much the same, being a light sandy loam, with a clay subsoil. The field is level, but not wet, the height above a neighboring depression, where pear trees are planted and water stands at times, being 6 or 8 feet. The soil is quite uniform.

The orchard consists of three north-and-south rows in an open field, a part of which is devoted to apples, pears, quinces, and peaches. The field is not very fertile. The open space to the west, as well as the strip between the tree rows, was sowed to winter wheat in 1889, with 400 pounds per acre of cheap phosphate. This wheat is now headed out (May 22, 1890) and does not promise over 20 bushels per acre, if as much. Three strips 12 feet wide occupied by the tree rows were left unsowed. These strips have been plowed and are now mellow and free from grass and weeds.

The field is within three-fourths of a mile of Dover Green and has probably been in cultivation more than one hundred and fifty years.

Nothing is known as to the original timber, but some good-looking chestnuts grow in the vicinity.

Experiment CVI.

Preliminary examination (*May 22, 1890*).—This experiment consists of the west row. The trees have made a nearly uniform vigorous growth, but four of them are replants one year younger and considerably smaller. There are 28 trees. The south half are Smocks and the rest are some other yellow fruit. All are healthy.

First treatment (*May 22, 1890*).—Each tree of this row received 15 pounds of dissolved bone ash (15 per cent soluble and available, P_2O_5). In addition, the south 4 trees received 6 pounds each of muriate of potash and the remainder 7 pounds each. These substances were weighed out for each tree and sowed separately. The distribution was as even as possible over a radius of 6 to 8 feet, extending as far as the spread of the branches and presumably as far as the greater part of the root system. The fertilizers fell upon moist earth and were at once dug into the soil carefully, no effort being made to keep them from touching the trunks.

First result (*September 15, 1890*).—Nine cases of yellows—nearly one-third of the whole number of trees. Among the number is one of the replants.

Remark.—The treatment was abandoned, but the trees were kept under observation.

Second result (*September 19, 1891*).—The old cases are worse than last year and there are nine new cases, including two of the replants. Two of these cases showed symptoms of disease in early spring.

SIXTY-FIRST CONTROL.

Preliminary examination (*May 22, 1890*).—This is the middle row of Plate XXXII. It contains 28 trees and three vacant places, and is now the most uniform and best-looking row of the three. All of the trees are healthy.

First result (*September 15, 1890*).—Five cases of yellows, *i. e.*, less than on either treated row. The amount and color of the foliage are about the same as on the west row, but it is much less green and abundant than on the east row. *September 30.*—The amount of foliage still remaining and the general appearance of this row is shown on Plate XX. This photo also gives a good idea of the field, which was in red clover at the time.

Second result (*September 19, 1891*).—There are twelve new cases, three of which showed symptoms in early spring.

Experiment CVII.

Preliminary examination (*May 22, 1890*).—This experiment consists of the east row, nearest Queen street. There are 26 trees. All are healthy but one, which developed slight symptoms of yellows in 1889. With exception of one replant, which is small, the trees are of nearly uniform size and appearance. The north 10 trees are white fruit. The rest are some yellow variety.

First treatment (*May 22, 1890*).—The north four trees of this row each received 9 pounds of dissolved bone ash and 10 pounds of nitrate of potash. Each of the remainder received 14 pounds of dissolved bone ash and 7 pounds of nitrate of potash. These substances were weighed out, sowed separately, and at once dug into the soil over the same area and under the same conditions as on CV.

First result (*September 15, 1890*).—Eleven new cases, *i. e.*, more than on either of the other plats. The old case is also worse than last year, although it has responded vigorously to the stimulus of the fertilizer.

September 30.—Premature branches on two trees have blossomed. The contrast between the amount of growth and general appearance of the trees of this row and of the other two, which look much alike, is very striking. See Plates XXI and XXII from photographs of individuals selected at random from the two treated rows. The row that had the complete fertilizer holds all its leaves and is still very green, while the other, which had only potash and phosphoric acid, has dropped a large part of its leaves and is preparing for winter.

Second result (September 19, 1891).—Five new cases. Two of these were diseased in early spring. The old cases are worse than last year.

REMARK.—In comparison with the other rows there are fewer new cases on this row than might have been expected, if growth into late autumn and consequent immaturity of the wood have anything to do with causing yellows. To put the facts in another way, three-quarters of the cases this year are in trees which ripened their wood early and went into the winter in a mature condition (contrast Plates XX, XXI, and XXII).

GENERAL REMARKS.

1890: *May 22.*—Vegetation is advanced and the treatment is late, but very heavy and on permeable soil, so that with the ordinary rainfall a very considerable portion must reach the roots this season. The leaves and shoot-axes are about one-sixth to one-fourth their full length. Some of the trees (Hales Early) bear a few peaches, which are about 1 inch in diameter.

July 18.—The effect of the bone and nitrate of potash is very marked, and Mr. Fulton says it began to show soon after the treatment.

September 15.—At a little distance the outer row, which received the complete fertilizer, appears to be remarkably healthy. The foliage is larger, darker green, and much more abundant, and the growth of the trees has been from one-third to one-half greater than on the other rows. In comparison they appear to have made a meager growth and to be scantily provided with leaves, but such is not really the case. As yet almost none of the leaves on this row have begun to drop or even turned yellow, while on the other rows some have fallen, many are yellowing, and none are deep green. These trees have, however, a better, more natural luxuriance than those dosed with guano (Series III, Exp. XLIII). The spring foliage is green and vigorous looking, even on the trees which are full of the sickly, feeble shoots indicative of yellows.

In vigor of growth, amount, size and, color of foliage there is little difference between the row which received heavy doses of bone ash and muriate of potash and the row which received nothing (compare Plate XXI with trees in the foreground of Plate XX.) On the whole, the innermost (treated) row, is now the best, but the difference is slight.

The orchard bore no fruit in 1890, another evidence that over-bearing has nothing to do with the appearance of yellows. June and July were very dry.

September 30.—The weeds are *Œnothera biennis*, *Erigeron canadensis*, *Leucanthemum vulgare*, *Amarantus*—, *Daucus carota*, *Bidens frondosa*, *Panicum sanguinale*, *Setarias*, etc.

1891: *April 11.*—The buds on the diseased trees are about a week in advance of the healthy ones, and many have been nipped by frosts. The trees are not yet in blossom.

July 20.—The trees look yellow and most of them are prematuring their fruit. For the first time the trees bear a crop. The nitrogen stimulus on the outer row has disappeared and there is now not much difference in amount, color, or vigor of the foliage on these three rows.

September 19.—Each row has made sufficient growth and is well provided with foliage. The rows are alike. The nitrogen produced no effect this year. Thirty trees are still healthy, *i. e.*, about one-third. Part of last year's cases have been dug out.

1892: The orchard was not examined for new cases this year. A general survey indicated no difference in favor of any particular row.

SUMMARY.

The cases by years are as follows:

TABLE XXXIV.—*Showing progress of yellows on 82 trees in the orchard of Jas. Alex. Fulton, Dover, Del.*

Year.	Cases.	Per cent.
1887	0	0
1888	0	0
1889	1	1.2
1890	25	30.5
1891	26	31.7
Total	52	63.4

The effect of the treatments is shown by per cents in the following table:

TABLE XXXV.—*Showing results of treatments in the orchard of James Alex. Fulton, Dover, Del.*

Plats.	1890.	1891.	Total.
	Per cent.	*Per cent.*	*Per cent.*
CVI (incomplete fertilizer)	32.1	32.1	64.2
Sixty-first control	17.9	48.2	66.1
CVII (complete fertilizer)	44	20	64

The results in this orchard agree with those obtained elsewhere. Some interesting conclusions may be drawn.

(1) The field is least abundantly provided with nitrogen; (2) large doses of bone and potash did not prevent the appearance of the yellows; (3) overbearing did not induce the disease; (4) the control was much freer in 1890, but the final result was the same.

SERIES XV.—ORCHARD OF JAS. W. GREEN, MAGNOLIA, DEL.

(Plate XXXIII.)

This orchard is south of Series III and separated from it by a level field of 30 acres. It contains about 28 acres. The trees were procured from the nursery of G. D. Jackson, a mile or two distant. They were grown from Kent County pits and buds and set in the spring of 1887, the distance apart approximating 20 by 20 feet. The total setting amounted to 3,007.

The trees made a good start, the few that died from transplanting or accidents of culture being replaced, so that there were no vacant places when these experiments began.

The orchard consists of ten common varieties of white and yellow fruit, arranged as follows, passing from west to east: St. John, Mountain Rose, Foster, Wager, Crawford Early, Old Mixon (free), Crawford Late, Fox Seedling, Walker Variegated (free), Smock. It bore no crops in 1887, 1888, 1889, or 1890. It has been pruned in the ordinary manner.

I had seen the orchard frequently every year since it was set and considered the early growth and appearance satisfactory. It was also a matter of some interest to watch for the first appearance of yellows. The treatment by years was as follows:

1887: Tilled in maize with the use of superphosphate.

1888: The east part was again planted to maize with the use of superphosphate. The middle portion was sown to winter wheat with the use of superphosphate. The extreme west end (12 rows) was set to strawberries and heavily manured.

1889: Red clover was sown in the spring on strips 8 to 10 feet wide midway between the tree rows, but the northwest corner was still kept to strawberries. The unsown strips, 5 to 6 feet wide on each side of the rows, were plowed and cultivated.

1890: The clover and strawberries were plowed down and the whole orchard was again put to maize. This last rather unusual procedure was owing to the appearance of yellows and to the failure of the orchard to set a crop.

The strawberries yielded well. The trees on that part sown to wheat are not over two-thirds as large as the others. Wheat checks the growth of a peach orchard much more than corn (see Bull. 1, p. 21).

Yellows first appeared in 1889. That spring there were three cases in the east end of the orchard. The owner dug about these trees, fertilized them in various ways, and supposed them to be cured, but subsequent examinations showed that such was not the case. No other trees became diseased that year, and the growth and appearance of the orchard was still satisfactory.

In 1890 yellows suddenly appeared in all parts of the field, and there was a large increase of cases, so large indeed that the whole orchard gave promise of speedy decay.

The trunks of these trees were twice washed—spring of 1889 and 1890—with the lime nostrum sold by J. J. Fees, but without benefit. Quite a good many of the diseased trees were also bored and plugged with a secret mixture (containing lime, sulphur, and sulphate of copper) sold by Capt. Bonsell, but this was also a dead loss. Both were employed much as a drowning man catches at straws, although recommended by the proprietors in glowing terms as tested and certain remedies.

The field is level; there is no artificial drainage, but the land is 10 or 15 feet above neighboring small streams and of such a character that water does not stand.

The field is bounded on the north by the level wheat field mentioned in Series III; on the east by an old peach and apple orchard set on level ground, which some 30 rods farther east slopes into a swampy forest; on the south by the highway, beyond which are level sandy fields succeeded by more peach orchards; on the west by the highway, beyond which is an open pasture sloping into a small, marshy-bordered brook a few rods distant.

The soil is sandy, being considerably lighter than that of Series III. The subsoil is a porous yellow clay. The field is apparently less fertile than Series III. It is light, warm, sassafras land, which in this vicinity has always been esteemed for peaches, the crop being more certain and the quality better than on the stiff clay lands in St. Jones' Neck.

Only two sets of experiments were undertaken, *i. e.*, with dung and with nitrogen compounds, the latter to determine whether an excess of nitrogen would induce yellows. These experiments were as nearly as possible a duplicate of those detailed in Series XI. They include several varieties, crossing them at right angles.

Experiment CVIII.

Preliminary examination (*May 9, 1891*).—This plat consists of eighty trees in a rectangle 4 by 20 in the northeast corner of the orchard. Four are cases of 1890. Six others now appear slightly suspicious. The rest are healthy and of nearly uniform size, but do not yet occupy all of the ground.

The surface is level and the soil quite uniform.

Treatment (*May 9, 1891*).—The west five rows each received one-half load of manure, the next six rows one-third load, and the east nine rows one-fourth load. Nearly all this manure came from the open yard and contained only a little dung, consisting principally of wet, half-rotten straw and cornstalks, but that put on the west two rows came from the cow stables and was rich in animal excrement, unleached by rain. It was plowed down May 11.

First result (*September 17, 1891*).—Mr. Green objected to this treatment, fearing it would cause an increase of yellows, but such was not the result. There are eight new cases, but all of them are on the east end, which received the least amount, and three of them were suspicious when the treatment began. These trees are only a little greener than the control, the best-looking ones being on the west end.

Second result (*October 21, 1892*).—Forty-four new cases, nine of which appeared after midsummer.

SIXTY-SECOND CONTROL.

Preliminary examination (*May 9, 1891*).—This plat joins CVIII on the south and is of the same size and general appearance, *i. e.*, eighty trees in a rectangle. Two are cases of 1890 and six are slightly suspicious. The rest are certainly healthy. The surface is level and the soil is the same.

First result (*September 17, 1891*).—The trees have made sufficient growth. There are ten new cases, two of which belong to the suspects of May 9.

Second result (*October 21, 1892*).—Thirty-five new cases; seven since midsummer.

EXPERIMENT CIX.

Preliminary examination (*May 8, 1891*).—This plat consists of eighty trees in a rectangle 4 by 20. It is bounded on the north by the sixty-second control and on the south by the sixty-third control, with either of which it is comparable. The plat contains five cases of 1890 and three trees which were healthy last fall, but are now slightly suspicious. The surface is level and the trees are of quite uniform size, except four replants.

Treatment (*May 8, 1891*).—This plat received 500 pounds of nitrate of soda. It was sowed by hand over about two-thirds of the whole surface—*i. e.*, on the parts nearest to the trees. Under the east forty-eight trees it was at once plowed down 3 to 4 inches, and on the west part was harrowed in a few days later, that part of the plat having been plowed already.

First result (*September 17, 1891*).—Eighteen new cases, one of which was suspicious in the spring. The trees of this row have made from one-third to one-half more growth than the controls to either side. The leaves are much more abundant, larger, smoother, very dark green, and still in full vigor. They very closely resemble those on Plats LXXXIX and XCIV.

Second result (*October 21, 1892*).—Thirty-five new cases, among which are the four replants. One case since midsummer.

SIXTY-THIRD CONTROL.

Preliminary examination (*May 8, 1891*).—This block consists of eighty trees, four of which are replants. One of these stands in place of a case of 1889. There are also three cases of 1890, and eight trees which were healthy in 1889, but which now look suspicious.

First result (*September 17, 1891*).—Twelve new cases, three of which were suspicious in the spring.

Second result (*October 21, 1892*).—Twenty-six new cases, six of which developed after midsummer.

EXPERIMENT CX.

Preliminary examination (*May 7, 1891*).—This plat contains eighty trees in a rectangle 4 by 20. It is bounded on the north by the sixty-third control and on the south by the sixty-fourth control, with either of which it is comparable.

The soil is level and quite uniform.

There are eight replants, one of which has recently taken the place of a case of 1889, and seven suspects of this spring. The rest of the trees are healthy and of quite uniform size.

Treatment (*May 7, 1891*).—The plat received 500 pounds of sulphate of ammonia. This gave to each tree 6¼ pounds, distributed evenly from the trunks outward, so that about two-thirds of the whole surface was covered, which, judging by the spread of the branches and facts brought out by various subterraneous examinations, is rather more than the amount of surface occupied by the root system. It was plowed down in a day or two to a depth of several inches.

First result (*September 17, 1891*).—There are eighteen new cases, three of which were suspicious in the spring. The trees have made from one-third to one-half more growth than the controls, and are overburdened with green leaves.

Second result (*October 21, 1892*).—Thirty-three new cases, four of which are replants. Nine cases since midsummer.

SIXTY-FOURTH CONTROL.

Preliminary examination (*May 7, 1891*).—This plat contains eighty trees in a rectangle 4 by 20, joining Plat CX on the south. All of the trees were healthy in the fall of 1890, but eight of them are now slightly suspicious. There are also five replants. The rest of the trees are of uniform size and thrifty appearance.

Remark.—It is now more difficult to pick out a case of yellows than it was a few weeks ago, or than it will be some weeks hence, when the foliage is larger, and consequently many of the suspects may be healthy trees.

First result (*September 17, 1891*).—There are sixteen new cases, two of which were suspicious in the spring.

Second result (*October 21, 1892*).—Eighteen new cases, one of which is a replant. Six cases since midsummer.

Experiment CXI.

Preliminary examination (*May 8, 1889*).—This plat consists of eighty trees in a rectangle 4 by 20. It is bounded on the north by the sixty-fourth control and on the south by the sixty-fifth control, with either of which it is comparable. The plat contains four replants, one of which stands in the place of a case of 1889. All the others are healthy and of quite uniform size. The soil is level and of very uniform appearance.

Treatment (*May 8, 1891*).—This plat received 500 pounds of dried blood, ground very fine and sowed in the same manner as on the other plats, *i. e.*, evenly over that two-thirds of the surface nearest to the trees. The east half was plowed down 3 to 4 inches at once. The west half was sowed on freshly plowed earth, which was harrowed soon after.

First result (*September 17, 1891*).—Five new cases. The trees have made from one-third to one-half more growth than the controls and now bear a superabundance of green leaves.

Second result (*October 21, 1892*).—Twenty-six new cases, five of which appeared after midsummer.

SIXTY-FIFTH CONTROL.

Preliminary examination (*May 8, 1891*).—This plat contains eighty trees in a rectangle 4 by 20, joining CXI on the south. There are two replants, two cases of 1890, and seven suspects of this spring. The remainder are healthy and of very uniform appearance.

First result (*September 17, 1891*).—Fourteen new cases, only one of which looked suspicious in the spring. The other suspects proved to be healthy trees.

Second result (*October 21, 1892*).—Twenty-eight cases, six of which appeared after midsummer.

GENERAL REMARKS.

1891: *September 17.*—The blocks which received $NaNO_3$, $(NH_4)2$ SO_4 and dried blood have made an astonishing growth, and, as already stated, are in marked contrast with the untreated strips. There is little, if any, difference in the three plats. From appearances, one would think each plat had received the same fertilizer. The dried blood acted just as quickly and as energetically as the nitrate of soda or the sulphate of ammonia.

The orchard bore a light crop, a spring frost having nipped most of the young fruits. According to Mr. Green, the fruit on the nitrated strips did not color well. Some varieties have been picked, but the Smocks and the Walker's Variegated still remain. These are very ripe on the controls, but still hard and green on the nitrated plats, there being fully a week's difference. In addition to being less brightly colored and retarded in their maturity, a considerable number of them on many trees of each plat are shriveling green, exactly as on Plat XLIII of Series III, which was dosed too heavily with guano. Nothing of the sort was observed on any of the controls.

October 24.—The contrast between treated and untreated, while still apparent, is no longer striking, a slight frost followed by heavy rains and winds having taken off three-fourths of the foliage.

There has been a great increase of cases this year, pretty generally distributed, and certainly not attributable to overbearing.

The back 7 acres occupied by these experiments were cultivated without crops. The rest of the field was planted to corn,—a poor growth.

All of the diseased trees remain, except the three cases of 1889.*

1892: *July 23.*—This orchard is much worse than last year. The old cases are still diseased and there are nine hundred and forty-five new ones. The orchard was plowed in spring and harrowed as usual during the fore part of the season, but is now somewhat weedy, the most common plant being *Cyperus phymatodes.* The soil is now being stirred with a disk harrow. Mr. Green has been "worming" the trees. There were borers in quite a good many trees, but only a very few have been seriously injured. Some of the worst bored trees are free from yellows, and some bad cases of yellows, which I examined particularly, were entirely free from injury by borers.

There is now no plain difference in the color of the foliage on the treated and untreated blocks.

The soil is quite dry. Mr. Green says the spring was wet and late, and that following this came a dry spell of five or six weeks. This has only recently given place to occasional rains; additional rains are much needed.†

The tops of most of the diseased trees, many of which were not yet bad cases, were removed in early spring. Many of these have put out a growth which is nearly healthy but not entirely so.

October 21.—Since the examinations of July 21–23, one hundred and fifty-one new cases have appeared, making a total of 1,096 this year. The July examination was critical, and if these one hundred and fifty-one trees had shown even slight symptoms they would have been included in that count.

None of the stubs have recovered, but their foliage is almost uniformly greener than that of the diseased trees which were not cut back.

The orchard was plowed after July and sowed to scarlet clover. It is now quite free from weeds. The roads are very dry and dusty.

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* The greater part were dug out in the spring of 1892, or cut back nearly to the trunk.

† The precipitation in inches at Dover from May 27 to July 23, 1892, was as follows: *May* 27, 0.59; *June* 10, 0.58; 21, 0.23; 27, 0.16; 30, 0.48; *July* 1, 0.29; 2, 0.07; 3, 0.27; 11, 0.08; 14, 0.06; 19, 0.41.

SUMMARY.

The cases by years in this orchard have been as follows:

TABLE XXXVI.—*Showing progress of peach yellows on 3,007 trees in the younger orchard of James W. Green, Magnolia, Del.*

Year.	Cases.	Per cents.	Year.	Cases.	Per cents.
1887	0	0	1891	337	11.2
1888	0	0	1892	1,096	36.4
1889	3	0.1			
1890	137	4.6	Total	1,574	52.3

The per cent of cases which appeared on the treated and untreated plats subsequent to May 9, 1891, is shown in the following table:

TABLE XXXVII.—*Showing results on treated and untreated plats in the younger orchard of James W. Green, Magnolia, Del.*

Plats.	Healthy trees.	Cases after treatment.			Per cent.		
		1891.	1892.	Total.	1891.	1892.	Total.
Treated.							
CVIII (dung)	73	5	44	49	6.8	60.3	**67.1**
CIX Na NO_3	74	17	35	52	23.0	47.3	**70.3**
CX (NH_4) 2, SO_4	73	15	32	47	20.5	43.8	**64.4**
CXI (dried blood)	79	5	26	31	6.3	32.9	**39.2**
Untreated.							
62	76	8	35	43	10.5	46.1	**56.6**
63	73	9	26	35	12.3	35.6	**47.9**
64	78	14	18	32	18.0	23.0	**41.0**
65	77	13	28	41	16.9	36.4	**53.2**

None of the plats escaped. The untreated plats show considerable variation, and the treated ones still more. The most cases in 1891 were on two plats which received nitrate of soda and sulphate of ammonia. The fewest are on those two which received animal manure, *i.e.*, dung and dried blood. In 1892 there was a large increase on all the plats, the smallest per cent being on control No. 64, and the next on the plat which received dried blood. If the extra cases on CIX and CX are attributable to overstimulation with nitrogen, it is difficult to explain the opposite result on CXI, which likewise received an excessive dose of nitrogen, and made an unusual and excessive growth, not distinguisnable from that on the other nitrated plats. The results do not show sufficient contrast to warrant very definite conclusions as to the effect of excess of nitrogen. Had the result on CXI agreed with that on CIX and CX, and had the per cent on 64 and 65 been lower, the difficulties in the way of drawing an affirmative conclusion would be less. As it is the probabilities are that the varying treatments had little or nothing to do with the results, or else that the effect of the nitrogen is obscured by the operation of other factors. This conclusion is also warranted by the fact that six rows on the south side of the sixty-fifth control (see map) which it was my intention to stimulate excessively with the hope of inducing a large number of cases, produced the excess of cases without any stimulus, that part of this series of experiments being abandoned for want of time. The result on this plat was as follows: Healthy trees, 117; cases in 1891 including 2 doubtful, 54; per cent 46.2. Cases in 1892, 38; per cent, 32.5. Total cases, 92; per cent 78.7. Here with similar soil, trees, and cultivation, there were twice as many cases the first year as on any of the stimulated plats. It is also possible to pick out several blocks of 80 trees each, in other parts of the orchard, which were not stimulated but which have developed as many cases as the plats which received the dung, nitrate of soda, and muriate of ammonia.

The great increase of cases in 1891 was for the most part in fine looking, thrifty trees. The same was true in 1892.

In case of the nitrated plats, the line of demarcation between treated and untreated was very distinct in 1891, but not in 1892.

CONCLUSIONS.

SUBSTANCES USED.

Separately, or in combination, the trees of these orchards received the following plant foods: Potassium, sodium, magnesium, calcium, sulphur, phosphorus, iron, chlorine, and nitrogen. These elements were applied in the form of lime, wood ashes, tobacco, barnyard dung, guano, potash salts, superphosphates and nitrogen compounds. Some of the plats received moderate doses; others, very heavy doses. Some of the treatments were made in spring; others, in autumn. In some orchards the fertilizers were plowed down; in others, they were harrowed in. These variations do not appear to have sensibly modified the results.

CURATIVE TREATMENT.

About 645 trees were diseased from the beginning of the experiments. None of these trees recovered, but a few of them improved to the extent of developing greener foliage and making more growth than neighboring untreated cases. This was true especially of the tree which received a large quantity of caustic lime, and of those which received tobacco dust and nitrogen compounds. The symptoms of disease, *i. e.*, premature fruit, pale-branched shoots, and prematurely unfolding winter buds did not disappear from any of these trees, and the most that can be said is that they did not pass into the final stunted and dying condition quite as rapidly. It is possible, therefore, that in some cases one or two additional crops of premature fruit might be secured by judicious fertilization, but such fruit is unfit for sale, and if treatments can produce no better result they are scarcely to be commended. Even the satisfaction of an improved appearance was not granted in a majority of cases, the trees becoming stunted, yellow, and worthless on soils heavily dosed with wood ashes, potash salts, and high-grade superphosphates.

The conclusions which appear to be warranted by these experiments are as follows:

(1) Peach yellows can not be cured by any ordinary fertilization of the soil.

(2) Some of the reputed cures have been made on trees not affected by yellows.—Experiment XC.

(3) In other cases, a somewhat improved appearance has been mistaken for recovery.

PREVENTIVE TREATMENT.

About 3,800 trees were subjected to various kinds of preventive treatment. These trees were entirely healthy and in fine condition at the beginning of the experiments. All of them were young, and many of them had the additional advantage of being selected in parts of the orchard where the disease had made the least inroads. Many of these trees received three and four treatments, but by the end of the third season 1,741 had become diseased. Moreover, the cases were more numerous the second and third season than the first, and yet more numerous the fourth, the total cases at the end of the fourth season being 2,368—*i. e.*, over 60 per cent. Even this does not express the whole truth, for the cases on Series XIV and on over one-half of Series XII are not recorded for 1892.

In the same orchards a large number of trees were held for comparison. The per cent of cases on the untreated plats varied considerably in different orchards and in different years, but not in such a way as to indicate that the treatments were of any advantage. On a few plats there is a difference in favor of the treatments, but it is either so slight as to be undoubtedly accidental or else contradicted by duplicates. On quite a good many plats the per cent of cases on treated and untreated is about the same, and probably the result would not have been different had the treatments and controls changed places. In three large orchards (III, IX, and XII) the treated plats as a whole developed more cases than the untreated in a given time, and this is especially noticeable on IX, where the Goessmann-Penhallow mixture was tried for a long time and on a large scale, with many duplicate plats. Indeed, on both IX and XII, up to the fall of 1891, there is such a considerable difference between treated and untreated that the treatments seem rather to have favored the development of the disease than otherwise.

Of the entire body of experiments it can be said without qualification that the fertilizers exerted no clearly defined restraining influence, and that three or four treatments at intervals of six months were not more successful than one or two, or than none whatever.

Results of this kind obtained from a few plats or from one season's work might, perhaps, be criticised as subject possibly to unknown local or seasonal peculiarities and not fairly representative, but the conclusions here recorded are the result of observations and experiments in fifteen orchards during four seasons, and can scarcely be open to objections of this sort.

Whatever may be thought of the inference that the fertilizers sometimes favored the development of the disease, the following conclusion seems to be fully warranted:

Peach yellows was not prevented by the addition to the soil of potash salts, superphosphates, or nitrogen compounds, in large or small doses, separately or combined, nor by the use of lime, wood ashes, guano, or barn-yard manure. Moreover, the treated blocks, as a whole, did not remain healthy for a longer period, did not develop fewer cases, and did not resist better toward the close of the experiments than at the beginning. Presumably, therefore, this disease is not due to any imperfection in soils arising from a deficiency of plant foods. This conclusion is strengthened by the fact that most of the trees showed the effects of the fertilizer very distinctly prior to the appearance of the disease, some of them having received four treatments and been under the influence of the fertilizer more than two years.*

ADDITIONAL FACTS AND INFERENCES.

These experiments also appear to admit of the following subsidiary conclusions, which are likewise supported by observations in many other orchards:

(1) Other things being equal, rapidly growing trees appear to be most susceptible.

(2) Growth of crops between trees does not specially favor the development of this disease.

(3) There is no proof whatever that overbearing causes or favors the development of yellows. Almost the whole body of these experiments might be put in counter evidence.

(4) With some exceptions, the blocks which held their leaves into late autumn in 1889, 1890, and 1891 did not develop more cases the following years than the controls which ripened their wood and shed their eaves early.

(5) To a certain extent the origin of trees seems to affect their resisting power. This problem is still under consideration.

(6) The results on treated plats and controls were not confused by any surface washing or side movement of fertilizers through the soil.

(7) The rate of diffusion of the superphosphates and potash salts in the soils of these plats is not known, but it is presumed that toward the close of the experiments these substances must have become pretty uniformly distributed through the soil and upper part of the subsoil, especially as crude sulphate of magnesia was used in many cases to

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* In some instances of this kind enough potash and phosphoric acid were put on to last twenty years.

hasten the downward movement of the potash. In any event the tendency of roots to grow toward a food supply is well known, and the extra growth of the treated blocks, as shown in the photographs, is sufficient proof that they made use of the fertilizers.

(8) The effect of nitrogen compounds applied in April or May was visible until late autumn but not the following season, except in one instance (Plat LXXXIX) which, however, was very well marked.

(9) Tobacco dust produced a distinct effect the following year.

(10) Excess of nitrogen caused an overproduction of wood and foliage at the expense of the fruit. The ripening of the latter was retarded very materially, and on several of the plats a part of the fruit shriveled green.

(11) It is not certain that excess of nitrogen favors the development of yellows (See 1).

(12) Wood ashes applied in spring did not produce any striking effect until the following spring.

(13) If large quantities of potash are desired for peach trees muriate of potash appears to be a better form for general use than kainit.

(14) The maximum number of cases occurred in one orchard the third year from planting; in several, the fourth or fifth year; in others, the sixth or seventh year; and in one, the ninth year.

(15) The year of most cases was 1887 in one orchard; 1888 in two others; 1890 in several others; and 1891 and 1892 in still others, 1889 being the only year when there was not a maximum in some orchard.

(16) There was an unexpected and great decrease of cases during the very rainy and rather cool season of 1889.

(17) The abnormally mild winter of 1889–'90 does not appear to have exerted any special influence on the progress of the disease.

(18) There was a large increase of cases in Delaware in the season of 1890 during and following a severe drought.

(19) There probably were more cases in Kent County, Delaware, in 1892, than any previous year—at least there were a very large number —and that summer also there was a dry spell which lasted five or six weeks, and a shorter drought in autumn.

(20) That part of an orchard surrounded or bordered by a forest is apt to be seriously affected first, but the *first cases* are not necessarily next to the forest nor is the disease long confined to any particular part of an orchard.

(21) The results on a number of plats, *e. g.*, XXXII, XXXIV, 14 and 15 of Plate XXV, show how necessary it is to have a series of experiments and to be cautious in drawing conclusions.

(22) In some orchards one variety was most affected on the start; in other orchards some other variety; and frequently the same variety proved more resistent in one part of the orchard than in another.

(23) Individual trees show very marked differences in their power of resistance, but all finally succumb.

EXPLANATION OF PLATES.

PLATES.

I. Ruins of Series I. Spring of 1891.

II. Ruins of Series II. Autumn of 1891. Bark of trunk and limbs still very smooth and sound, as also in Series I.

III. The end of Series IV. October 23, 1891.

IV. Series VI. (1) Plat LIV. Dissolved bone ash and nitrate of potash. Average healthy after two treatments. (2) Twenty-sixth control. Average healthy. Strictly comparable with No. 1. Note the dense leafiness of the treated Plat LIV in the background. Photos. October 9, 1890.

V. Series VI. Plat LIV. View down a double row after two years' treatment, showing exceedingly luxuriant growth, induced by the complete fertilizer. Photo. October 9, 1890. The tree shown in the foreground at the right became diseased in 1891. On this double row of twenty-six trees one case appeared in 1890; two in 1891; and eleven in 1892.

VI. Series VI. Plat LIV. View in early spring, showing advancement of foliage, method of pruning, manner of plowing, etc. The blossoms have fallen, and the foliage is beginning to grow rapidly. The small trees in the extreme background are the peaches budded on plum roots, forming Experiment I of Bull. 1. The farm road is at the left. Photo. April 24, 1891.

VII. Series VI. Twenty-sixth control. View down a double row. Strictly comparable with plat V. One case appeared in 1890; none in 1891; and thirteen in 1892. The location of the camera in each instance is indicated on the map by two arrows.

VIII. Series VI. Plat LV. Dissolved bone ash and muriate of potash. View down a double row. Photo. October 14, 1891. Strictly comparable with Plate IX. On this double row one case appeared in 1890; five in 1891; and ten in 1892.

IX. Series VI. Plat LVI. Dissolved bone ash and nitrate of potash. View down a double row, showing a larger growth than on Plat LV. Photo. October 14, 1891. The forest line is at the left. On this double row one case appeared in 1890; eight in 1891; and twelve in 1892.

X. Series VII. (1) Lime in spring of 1889 followed by muriate of potash in spring of 1890. Average healthy. (2) Twenty-eighth control. Case of 1890, a fine tree in first stage. This may be compared with figure 1 for amount of foliage on treated and untreated at this date. Photos. October 18, 1890.

XI. Series VII. Plat LVIII. Lime in spring of 1889 and nitrate of potash in spring of 1890. Excessive growth. October 9, 1890. One of these trees became diseased in 1891 and the other three in 1892.

XII. Series VII. Twenty-ninth control. Strictly comparable with the double row shown in XI. The foliage of the upper foreground belongs to the treated rows. Many branches had to be cut away from the latter to get any view. October 9, 1890. One became diseased in 1891, and two more in 1892.

XIII. Series IX. Experiment LXXXVII. Case of 1888. No. 2 of the excisions. One hundred and fifty pounds of wood ashes in fall of 1889. Photo. October 14, 1891. Badly diseased. In the background are stubs of diseased trees, and vacant places from which others have been removed.

XIV. Series IX. Plat LXXXIX. Nitrate of soda in spring of 1891. Healthy tree. Excessive growth. October 11, 1891. Asclepias cornuti, Erigeron canadensis, Setarias and Panicums, in the foreground.

XV. Series IX. Untreated, but in other respects strictly comparable with XIV. Normal growth and early maturity of shoots. October 11, 1891. A portion of the treated block appears in the background at the left (north).

PLATES.

XVI. Series IX. View east from northwest corner of Plat LXXXVI, showing cover of grass and weeds, method of pruning, size of trees, and small amount of foliage remaining October 14, 1891.

XVII. Series X. Plat XC. Tree dwarfed by root aphides and dosed with tobacco dust in fall of 1889 and spring of 1890. Photo. October 14, 1891. The amount of growth in two years is shown by paper tags on the branches, the distance from these points to the top of the tree being about 6 feet.

XVIII. Series XII. Plat C. Dissolved bone black and muriate of potash. (1) Healthy tree, foliage green. (2) Case of 1889. Tree dwarfed and foliage very yellow after two treatments. Healthy tree in background at right. Photos. October 4, 1890.

XIX. Series XII. (1) Plat CII. Dissolved bone black and nitrate of potash. Healthy. (2) Plat CIII. A duplicate of CII. Case of 1890, *i. e.*, after two treatments. Photos. October 4, 1890.

XX. Series XIV. (1) Sixty-first control. Row in background treated with incomplete fertilizer, dissolved bone ash, and muriate of potash. Photo. September 30, 1890.

XXI. Series XIV. Single tree from Plat CVI. Effect of incomplete fertilizer scarcely visible. September 30, 1890. Compare with Plate XX.

XXII. Series XIV. Single tree from Plat CVII. Effect of complete fertilizer very striking. September 30, 1890. For comparison with Plate XXI. The extra amount of foliage was induced by the nitrogen.

XXIII. Map of Series I, showing location of plats, cases of yellows by years, etc.

XXIV. Map of Series II, showing location of plats, cases of yellows, etc.

XXV. Map of Series III, showing location of plats, cases of yellows by years, etc.

XXVI. Maps of Series IV and V, showing location of plats, cases of yellows by years, etc.

XXVII. Maps of Series VI and VII, showing location of plats, variations of soil, cases of yellows by years, etc.

XXVIII. Map of Series VIII, showing location of plats, variations of soil, cases of yellows by years, etc.

XXIX. Map of Series IX, showing location of plats, cases of yellows by years, etc.

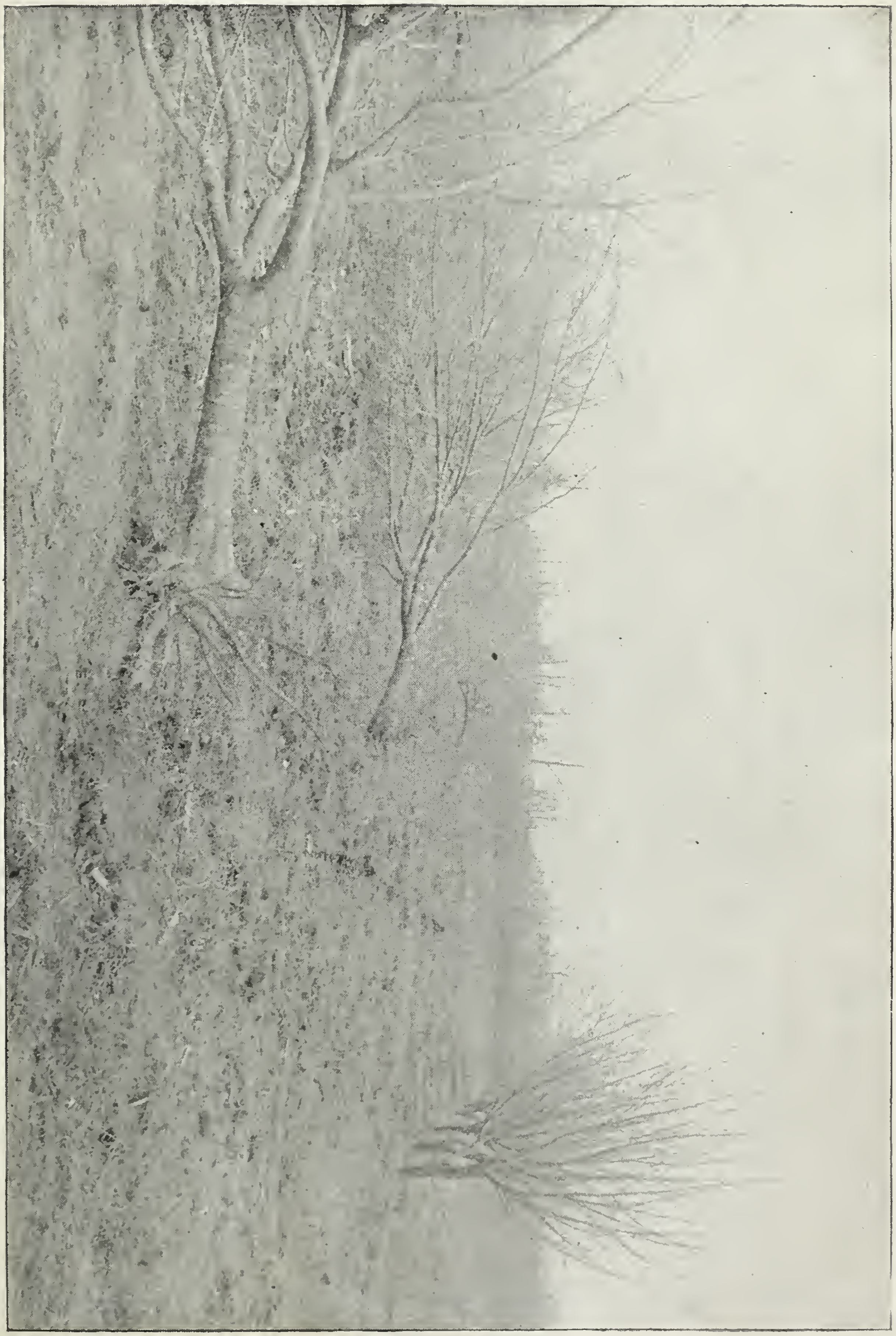
XXX. Map of Series XI, showing location of plats, cases of yellows by years, etc.

XXXI. Map of Series XII, showing location of plats, cases of yellows by years, trees removed in the spring of 1892, etc.

XXXII. Map of Series XIV, showing location of plats, cases of yellows by years, etc.

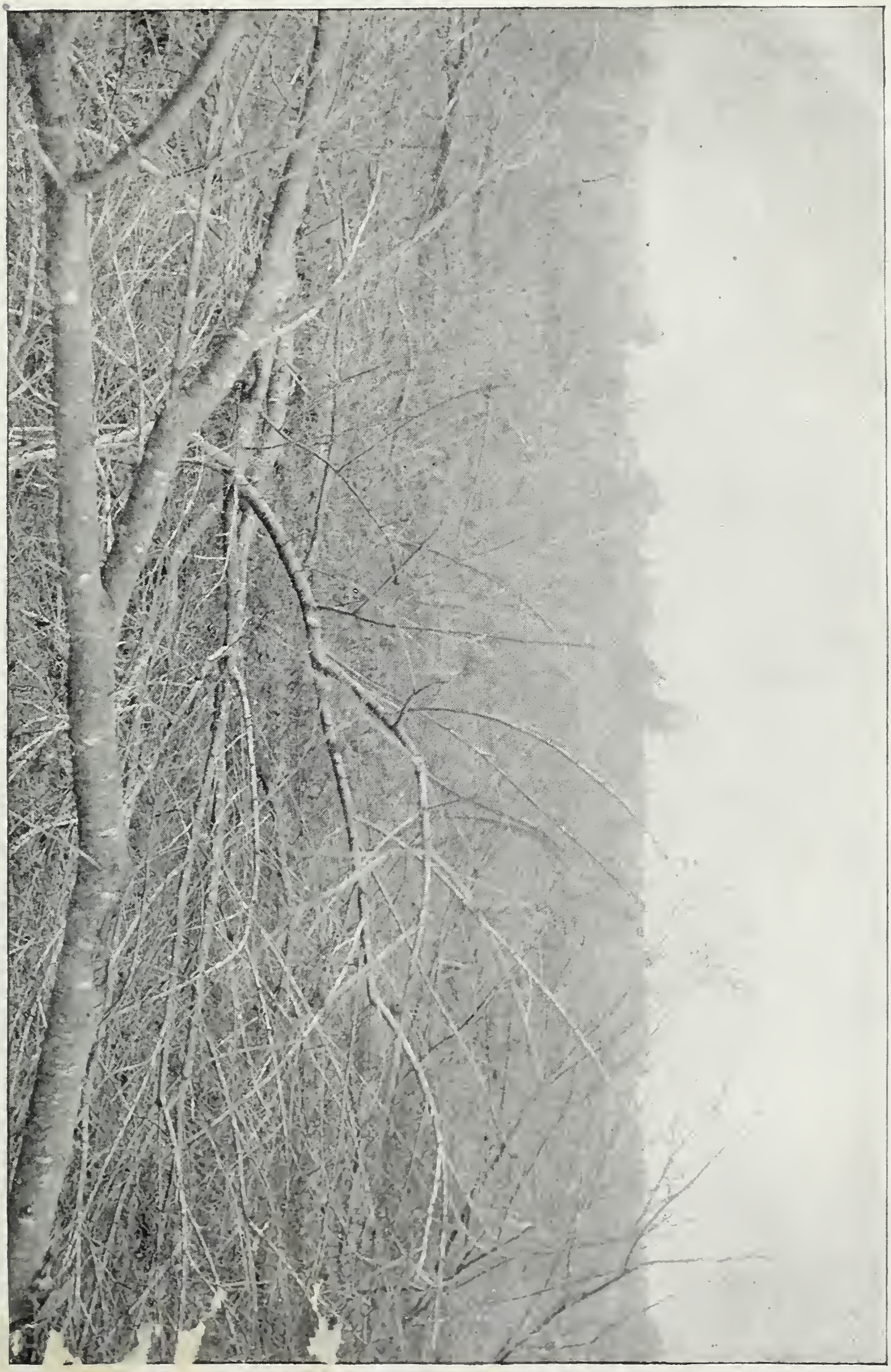
XXXIII. Map of Series XV, showing location of plats, cases of yellows by years, etc.

NOTE.—These maps are based principally on data gathered in the late summer and autumn of each year. They show the location of every case of yellows since its first appearance, and will enable the reader to compare the method of spread in this disease with that in diseases known to be due to root parasites, such as *Anguillula*, *Schizoneura*, *Phylloxera*, *Dematophora*, *Agaricus*, etc.



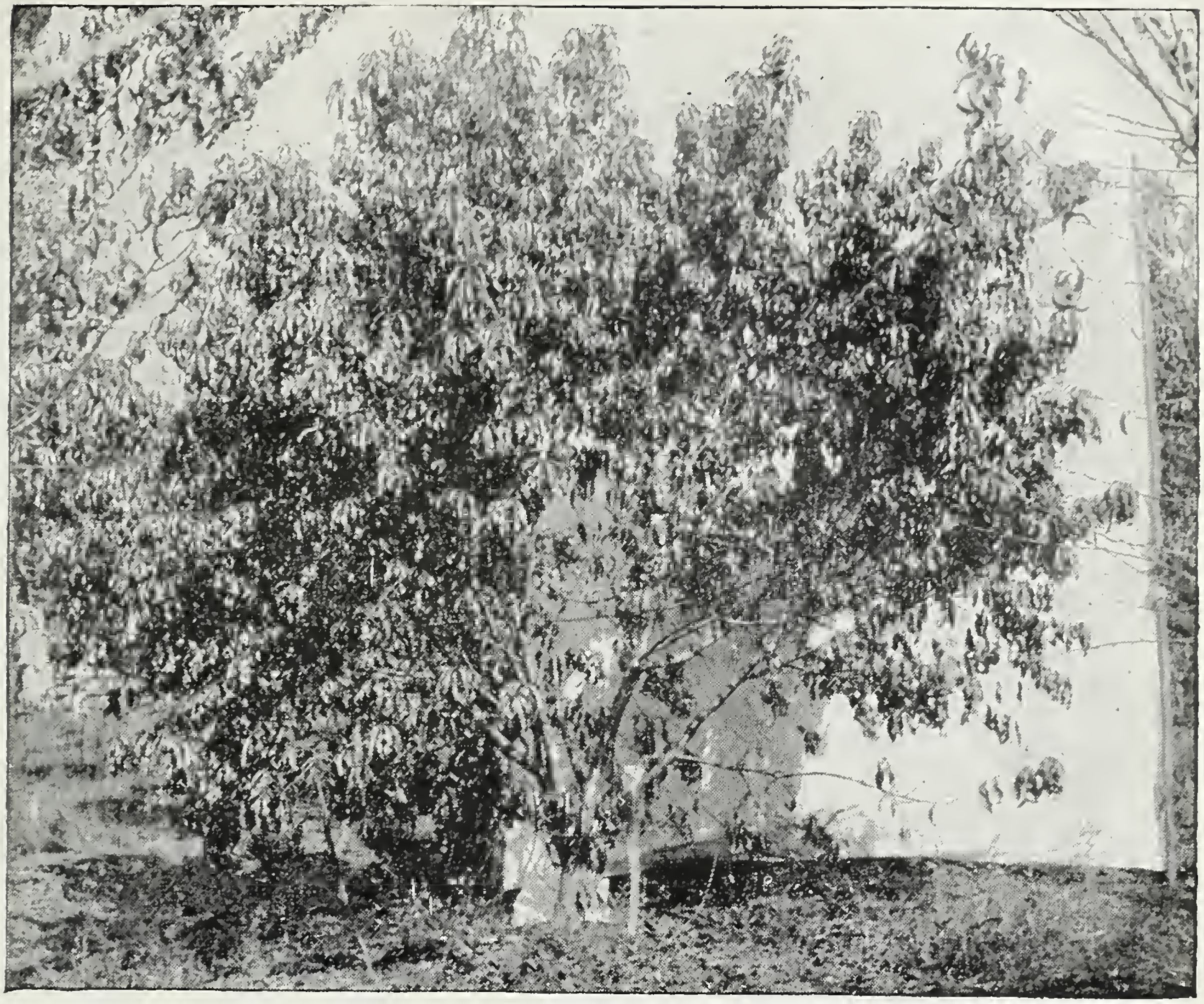
SERIES I.—GENERAL APPEARANCE OF ORCHARD IN 1891.

PLATE II.

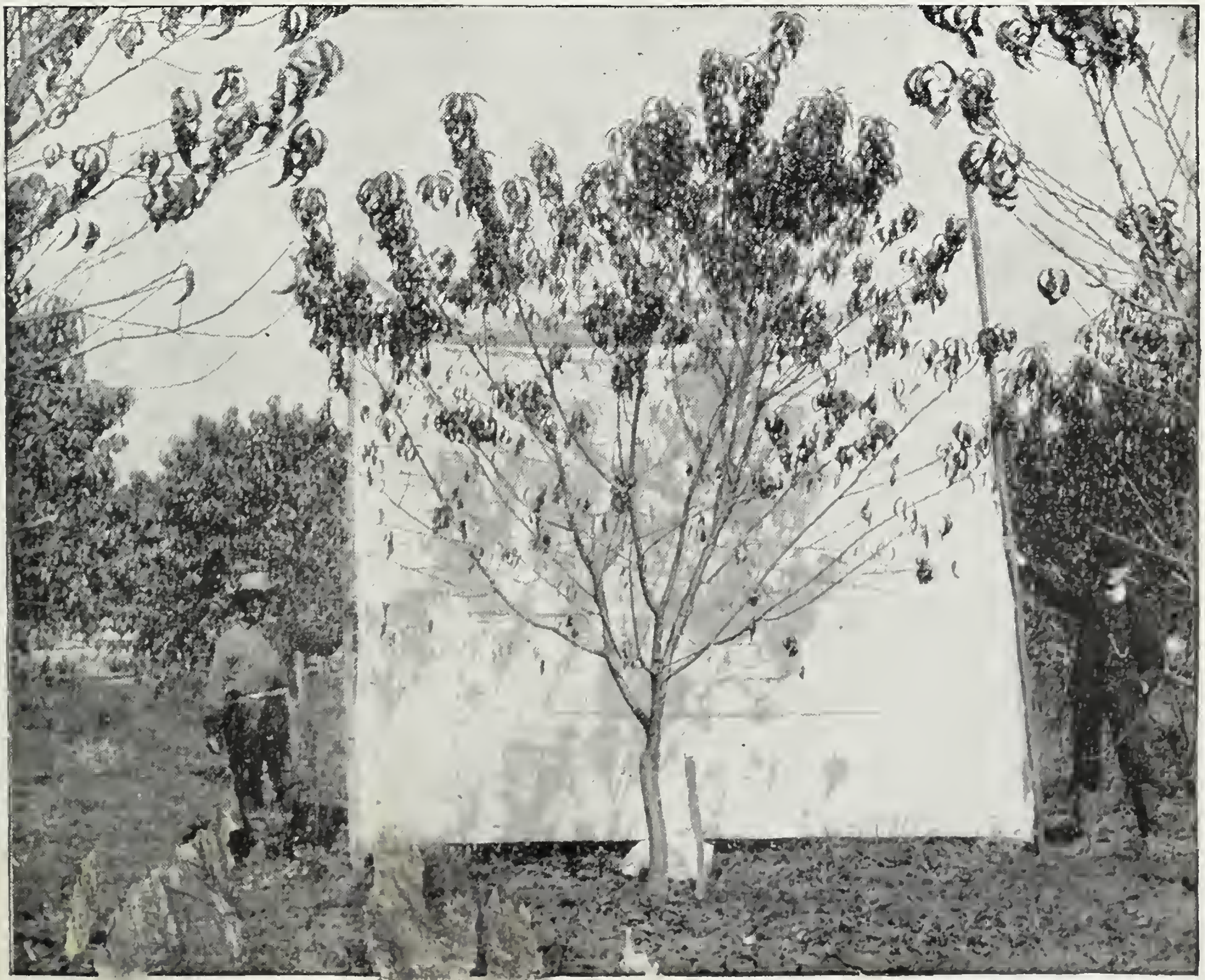


SERIES II.—GENERAL APPEARANCE OF ORCHARD IN 1891.

Series IV.—General Appearance of Orchard in October, 1891.

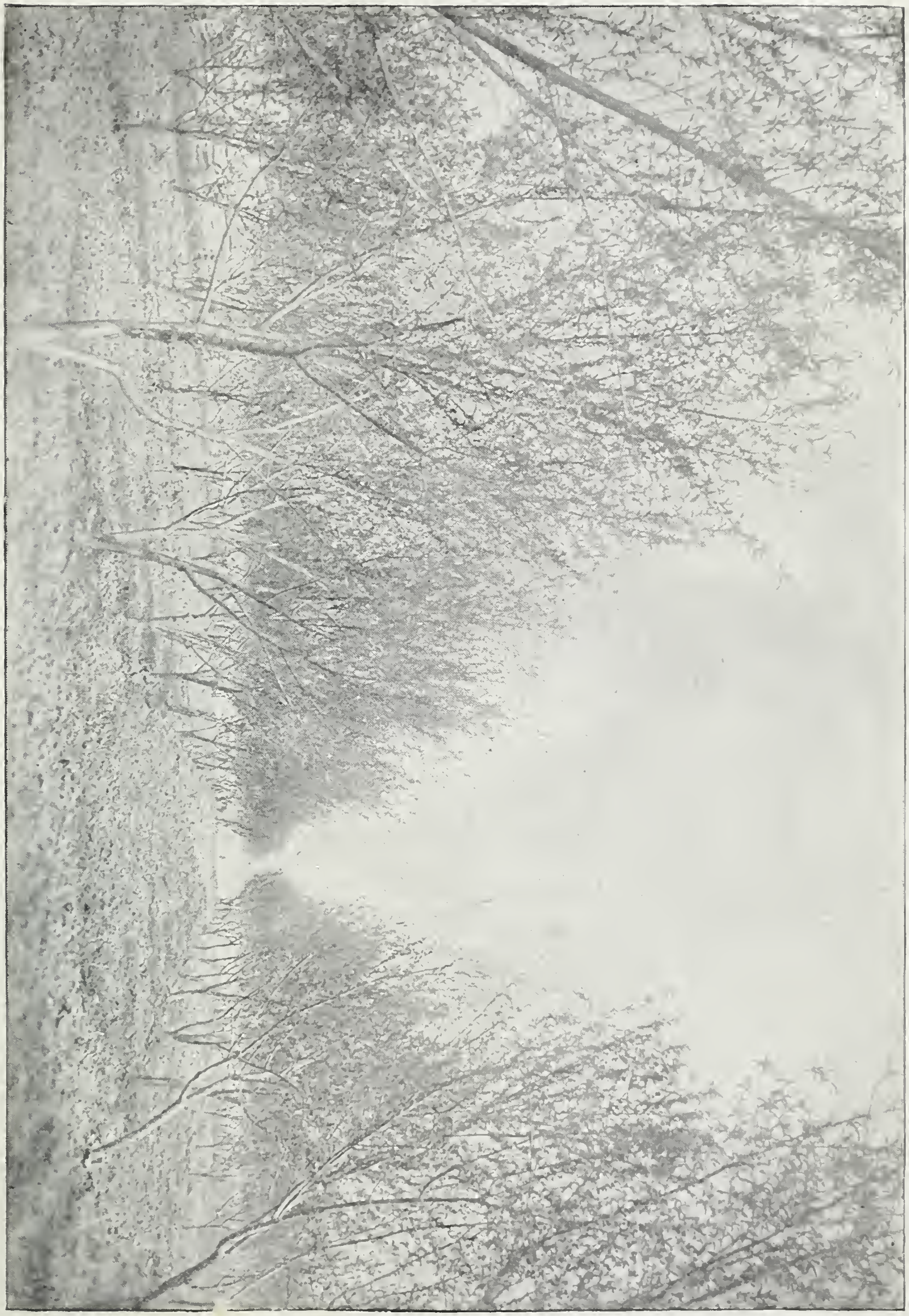


SERIES VI. – FIG. 1. DISSOLVED BONE ASH AND NITRATE OF POTASH. PLAT LIV.—HEALTHY.
OCTOBER 9, 1890.



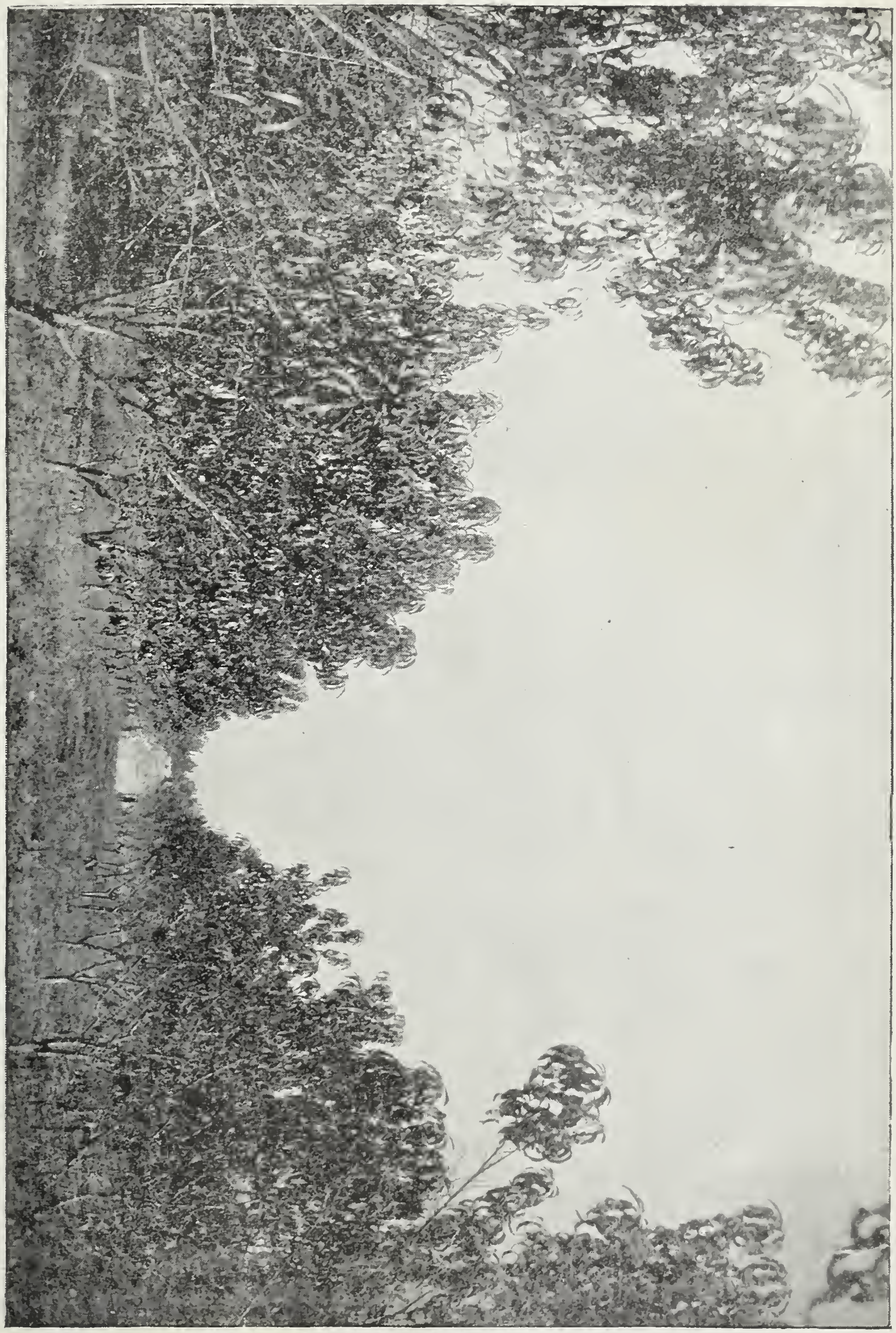
SERIES [illegible] —FIG. 2. TWENTY [illegible] NTROL. UNTREATED. HEALTHY. EXPERIMENT LIV
[illegible] HE BA[illegible]UND.

SERIES VI.—DISSOLVED BONE ASH AND NITRATE OF POTASH. PLAT LIV. OCTOBER 9, 1890.



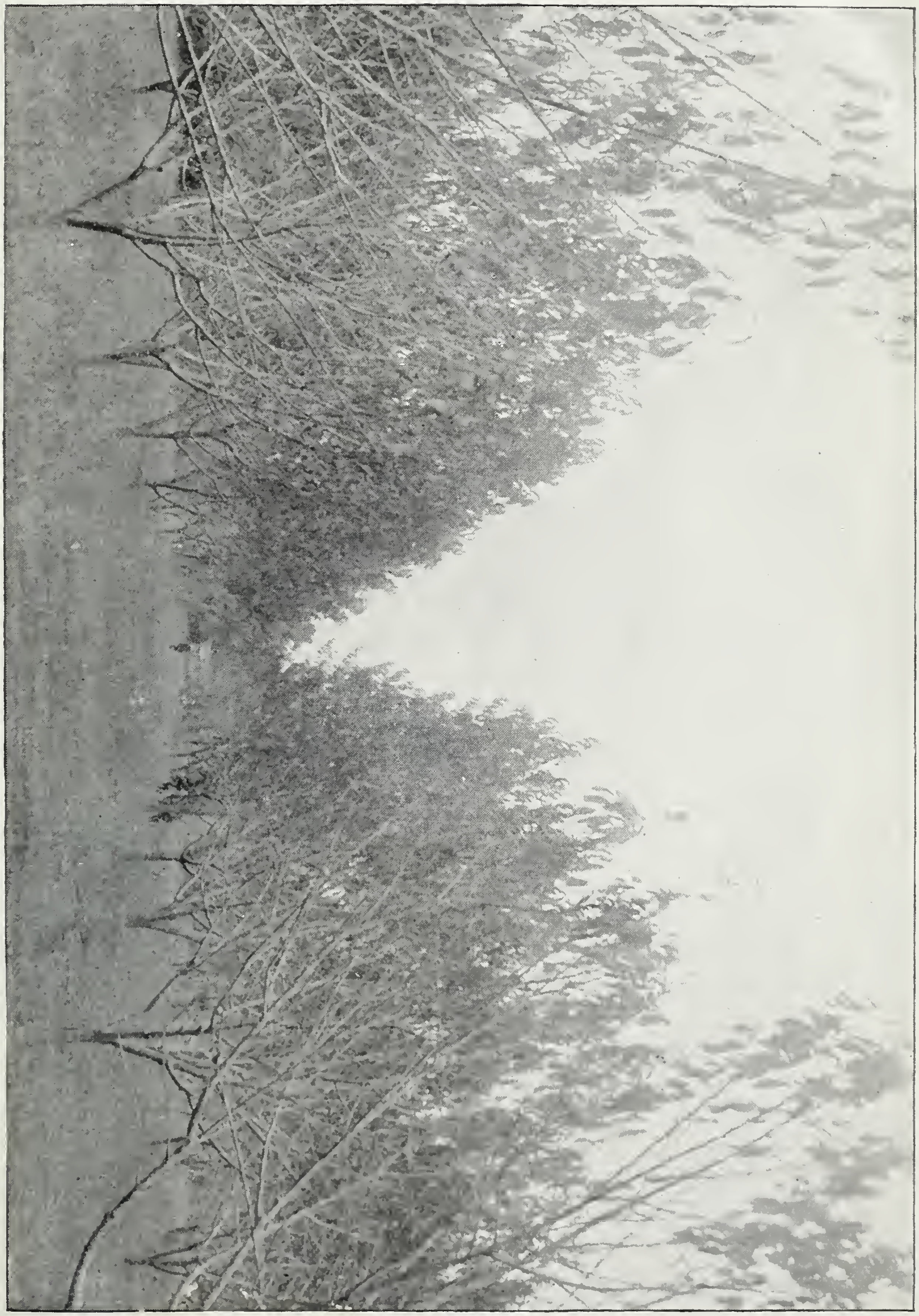
SERIES VI.—VIEW IN SPRING—APRIL 24, 1891. PLAT LIV.

PLATE VII.

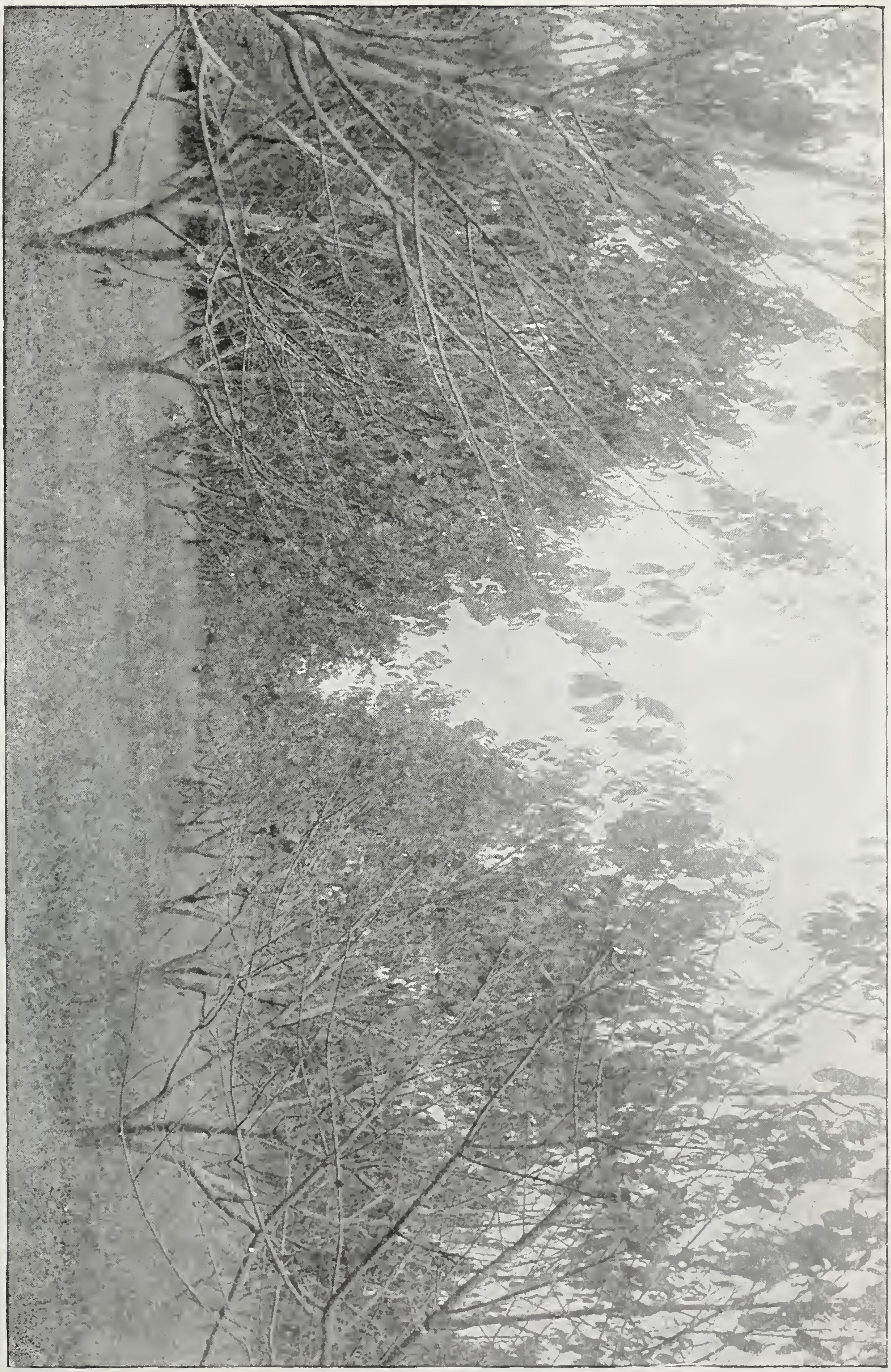


SERIES VI.—A DOUBLE ROW OF UNTREATED—THE TWENTY-SIXTH CONTROL.

(Strictly comparable with Plate V.)

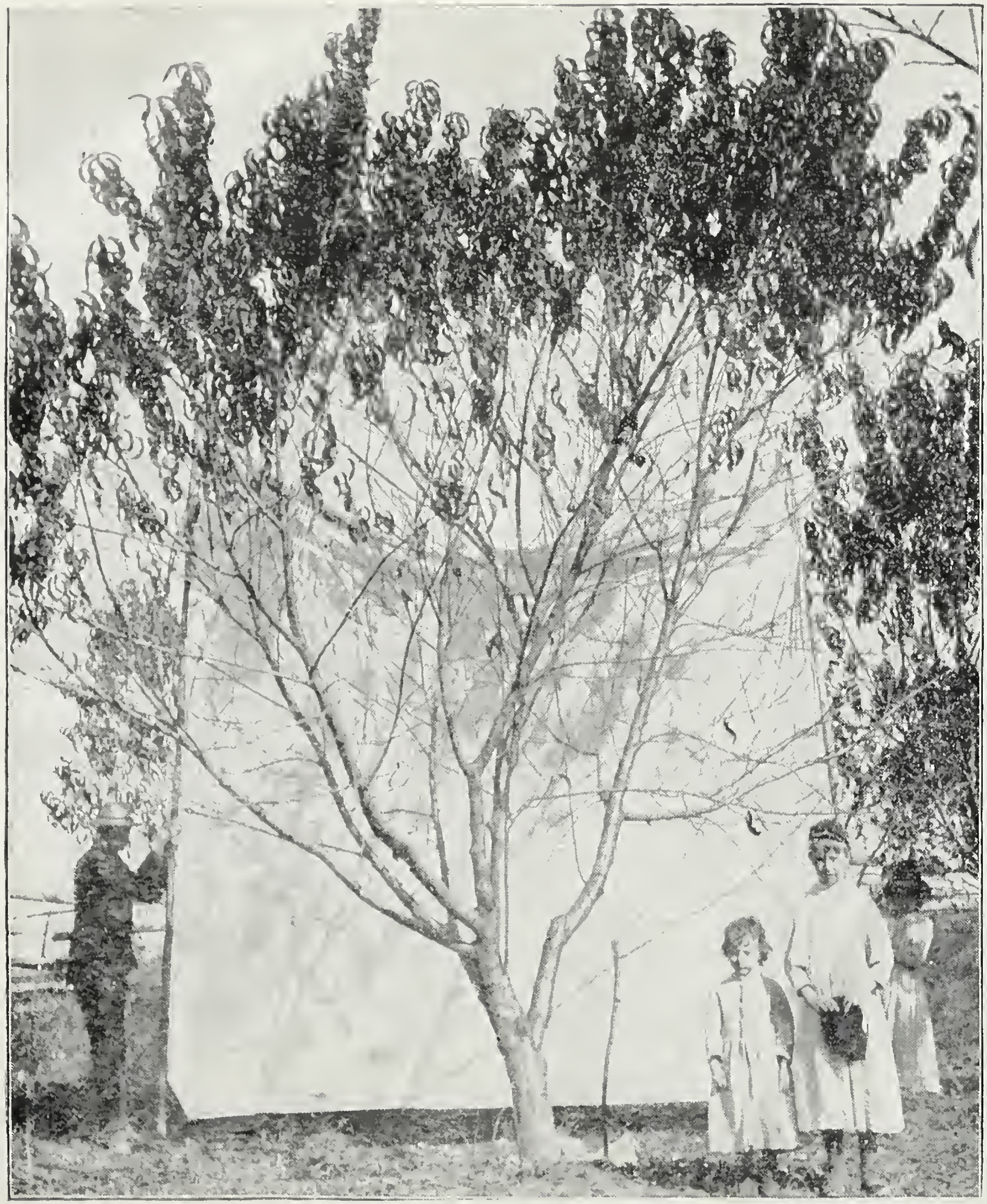


SERIES VI.—DISSOLVED BONE ASH AND MURIATE OF POTASH. PLAT LV. OCTOBER 14, 1891.

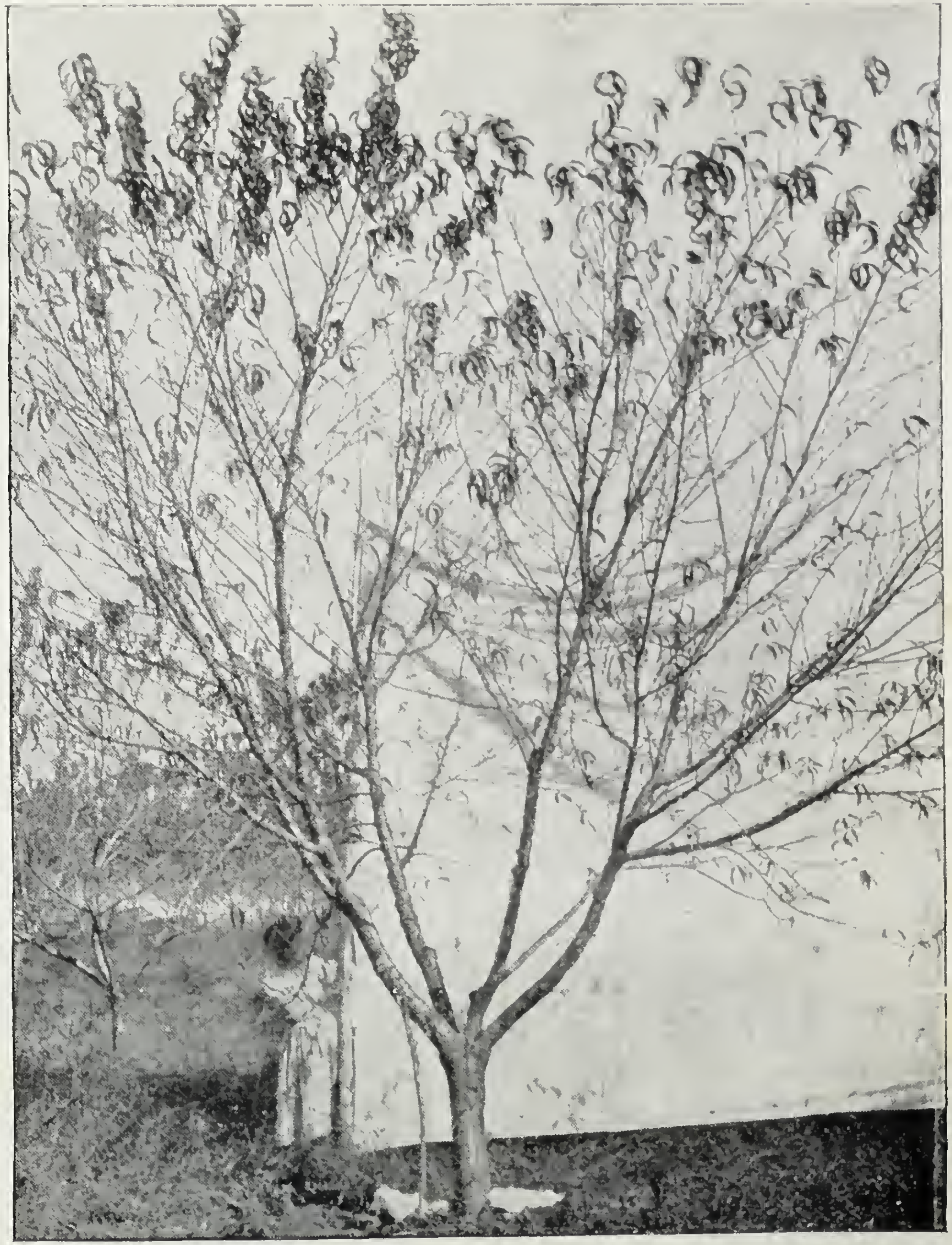


SERIES VI.—DISSOLVED BONE ASH AND NITRATE OF POTASH. PLAT LVI. OCTOBER 14, 1891.

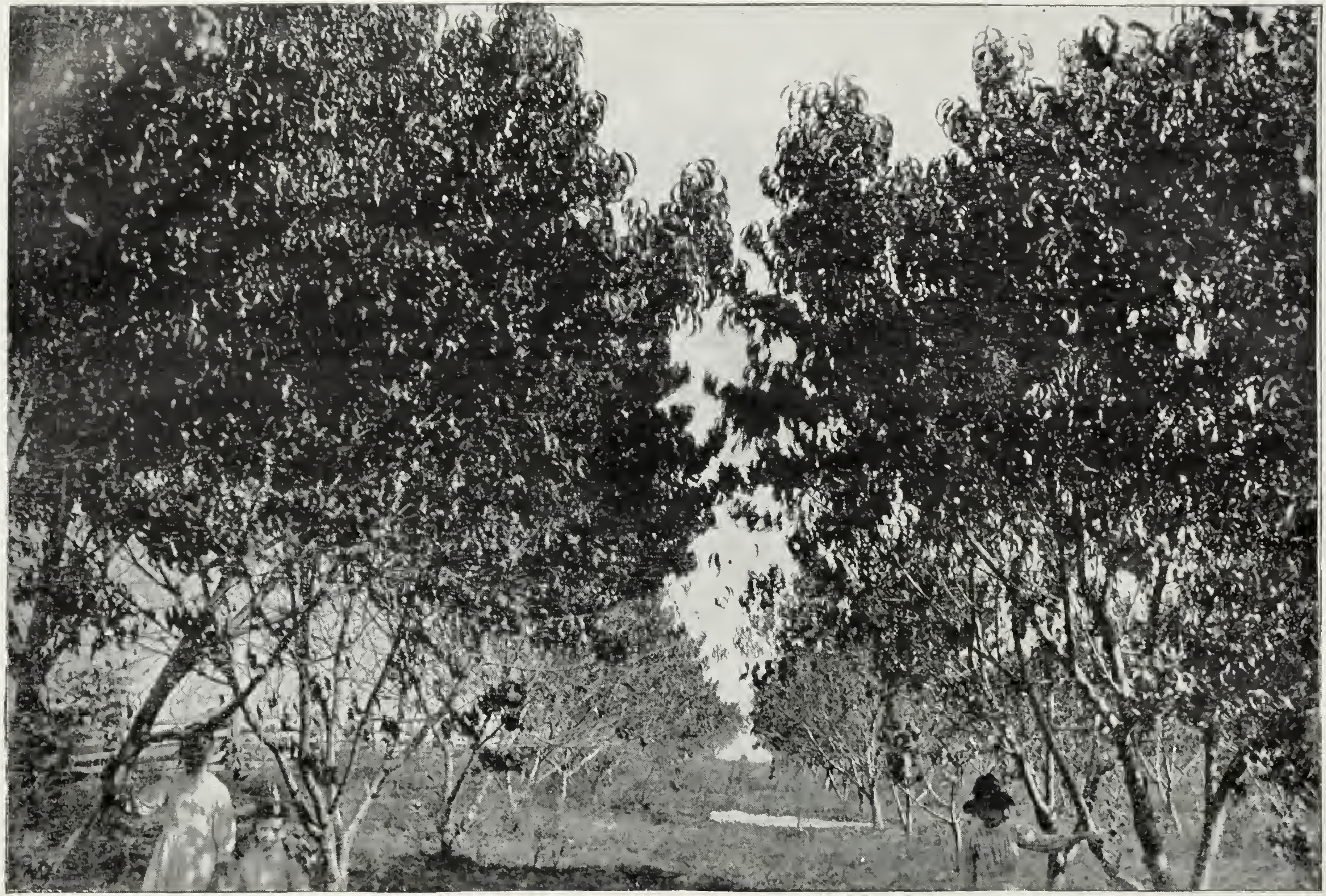
(Strictly comparable with Plate VIII.)



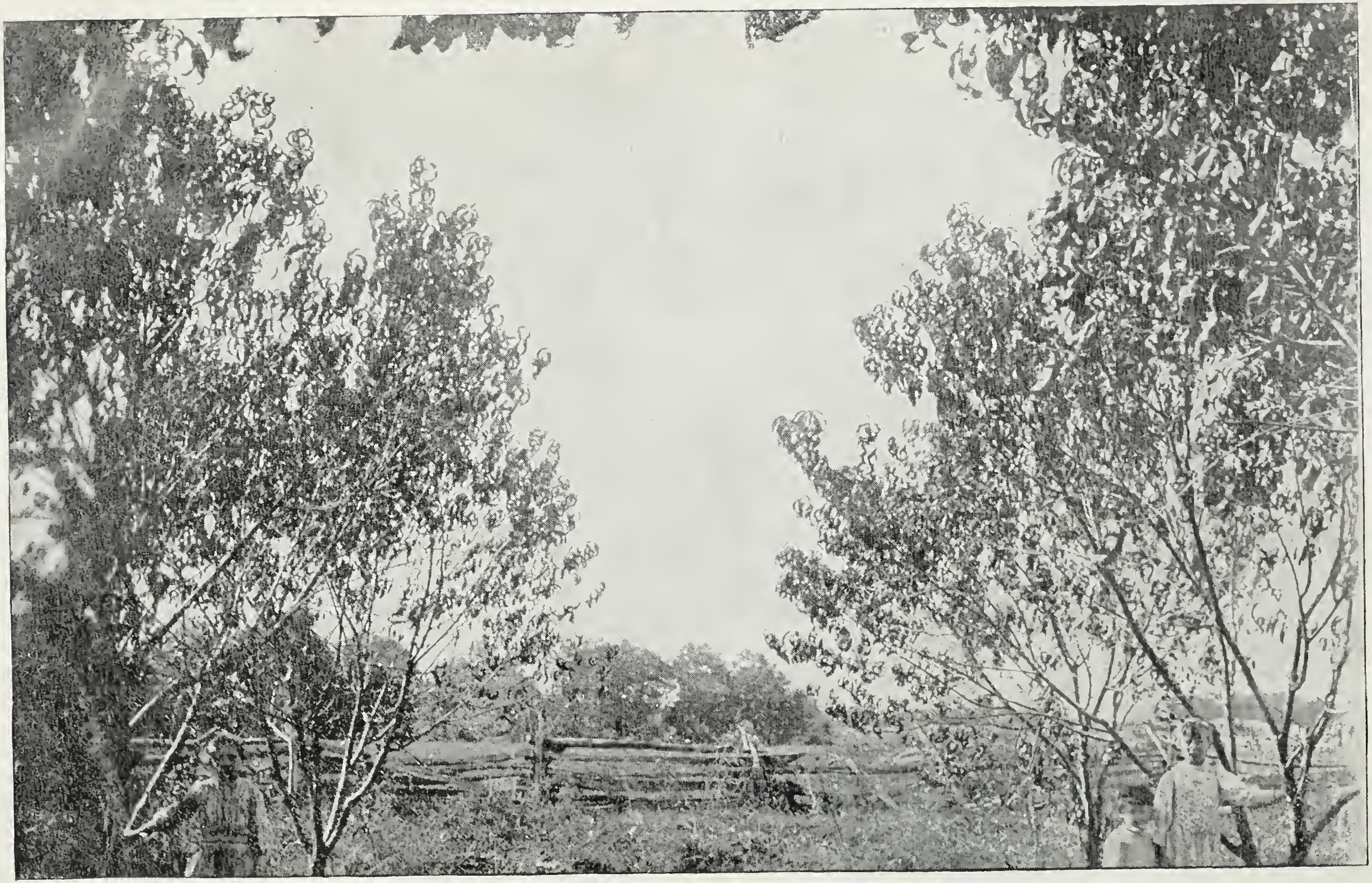
SERIES VII.—FIG. 1. CAUSTIC LIME FOLLOWED BY MURIATE OF POTASH.
A HEALTHY TREE. PLAT LVII.



SERIES VII.—FIG. 2. UNTREATED. CASE OF 1890. THE TWENTY-EIGHTH CONTROL.

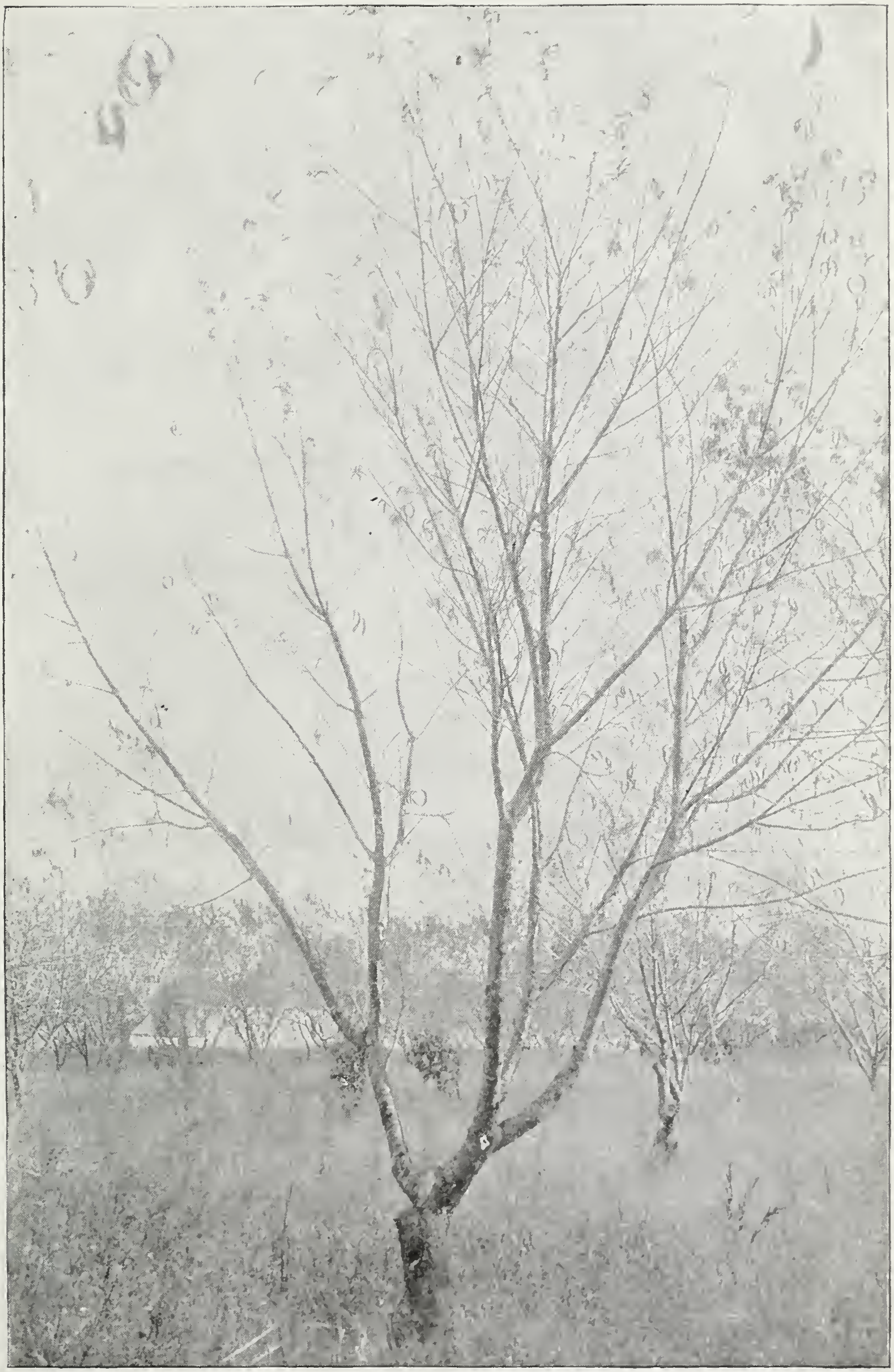


Series VII.—Caustic Lime followed by Nitrate of Potash. Plat LVIII. October 9, 1890.

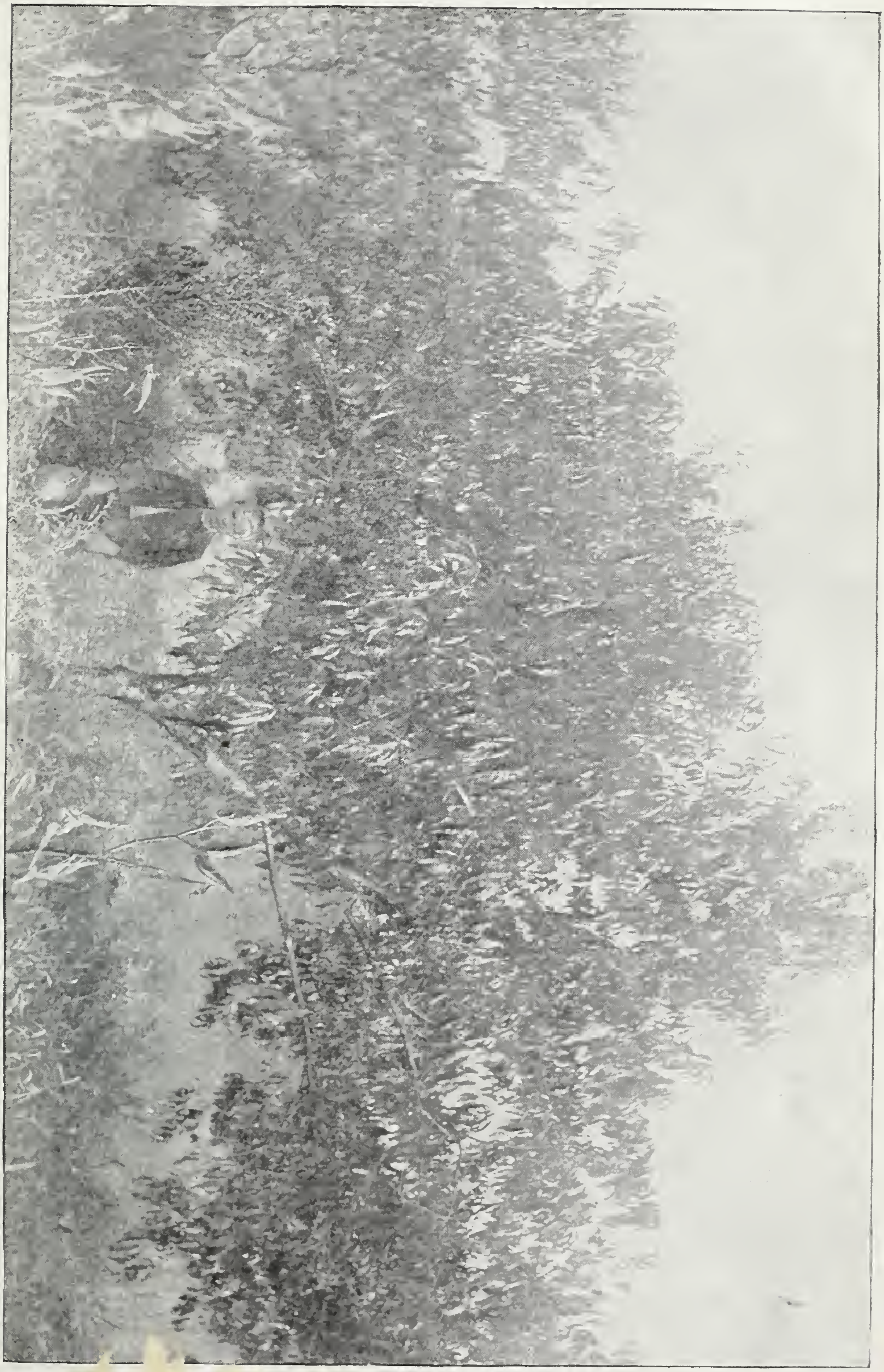


SERIES VII.—UNTREATED, HEALTHY TREES—TWENTY-NINTH CONTROL.

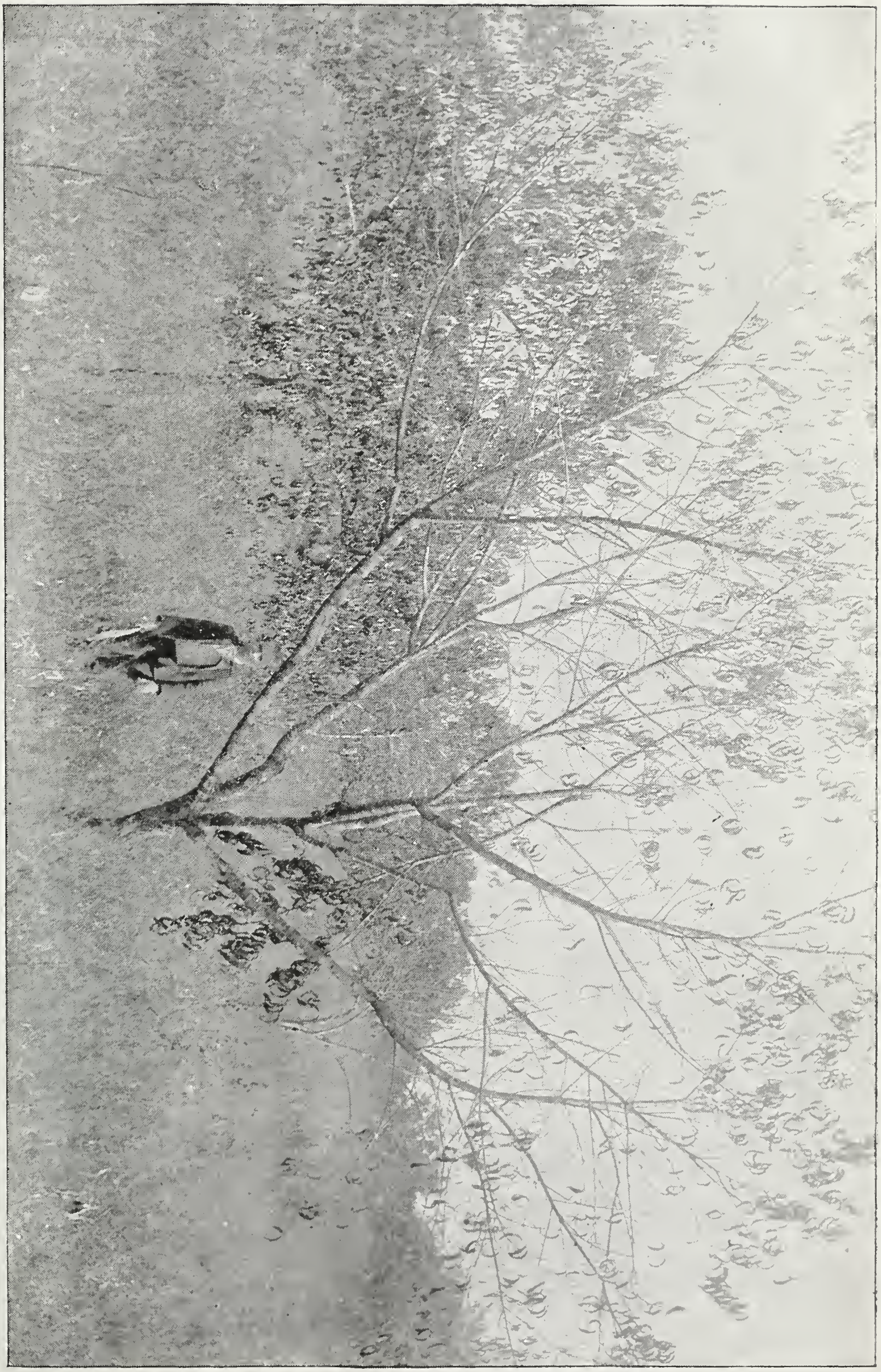
(Photographed Oct. 9, 1890, and strictly comparable with Plate XI.)



SERIES IX.—EXCISION FOLLOWED BY WOOD ASHES. EXPERIMENT LXXXVII. CASE OF 1888.
OCTOBER 14, 1891.

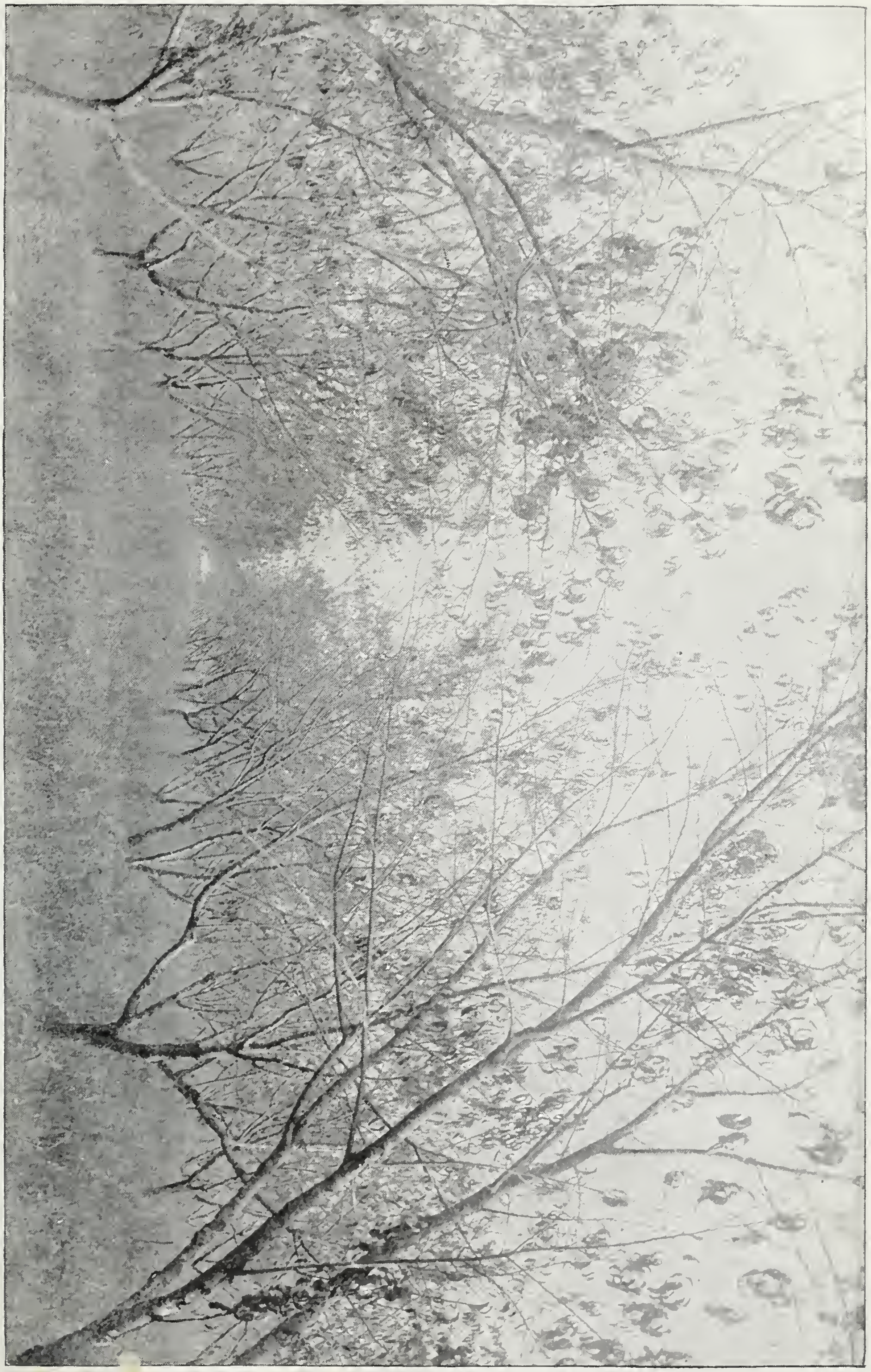


SERIES IX.—NITRATE OF SODA. PLAT LXXXIX. HEALTHY TREE—EXCESSIVE GROWTH. OCTOBER 14, 1891.

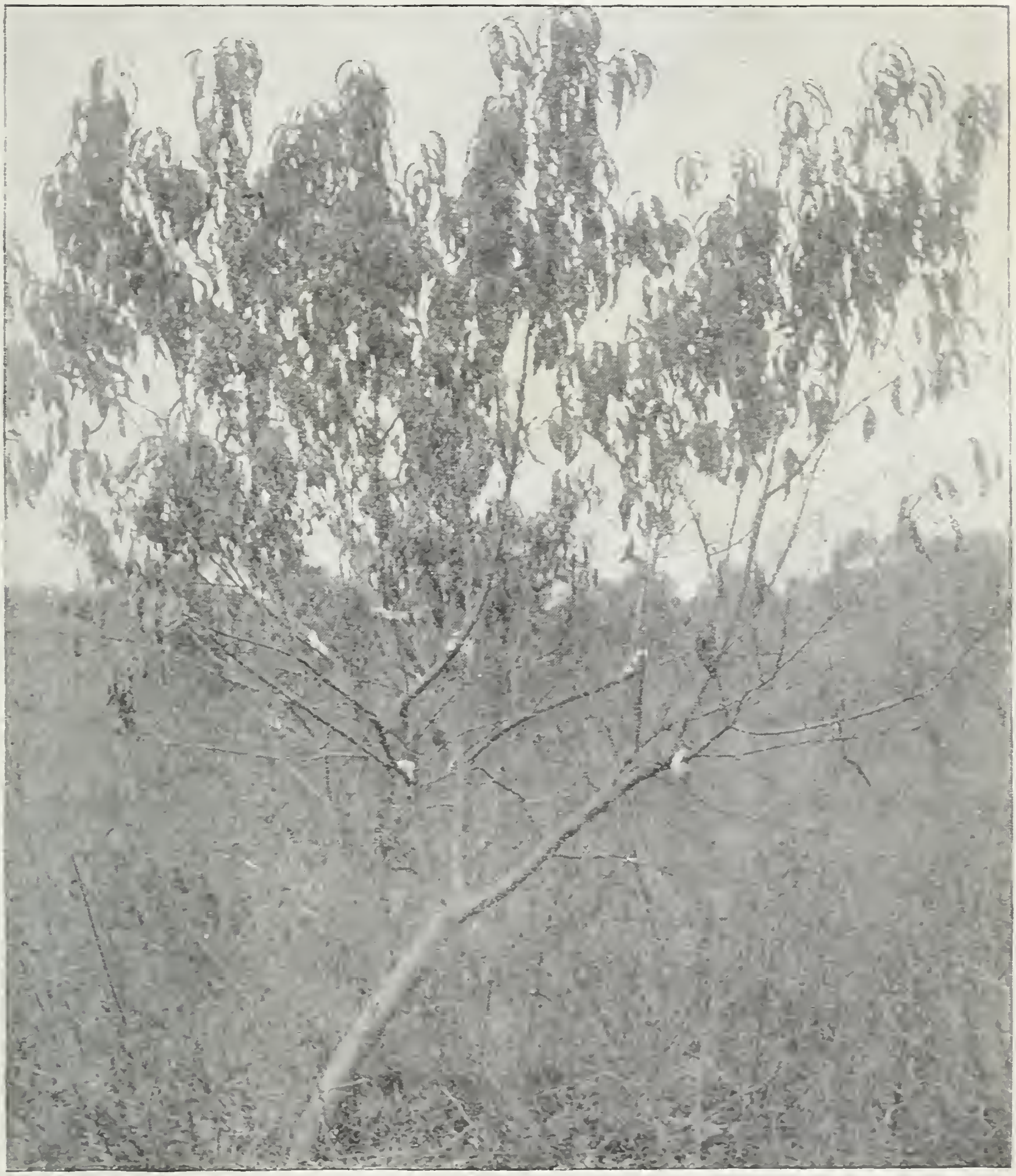


SERIES IX.—HEALTHY—UNTREATED.

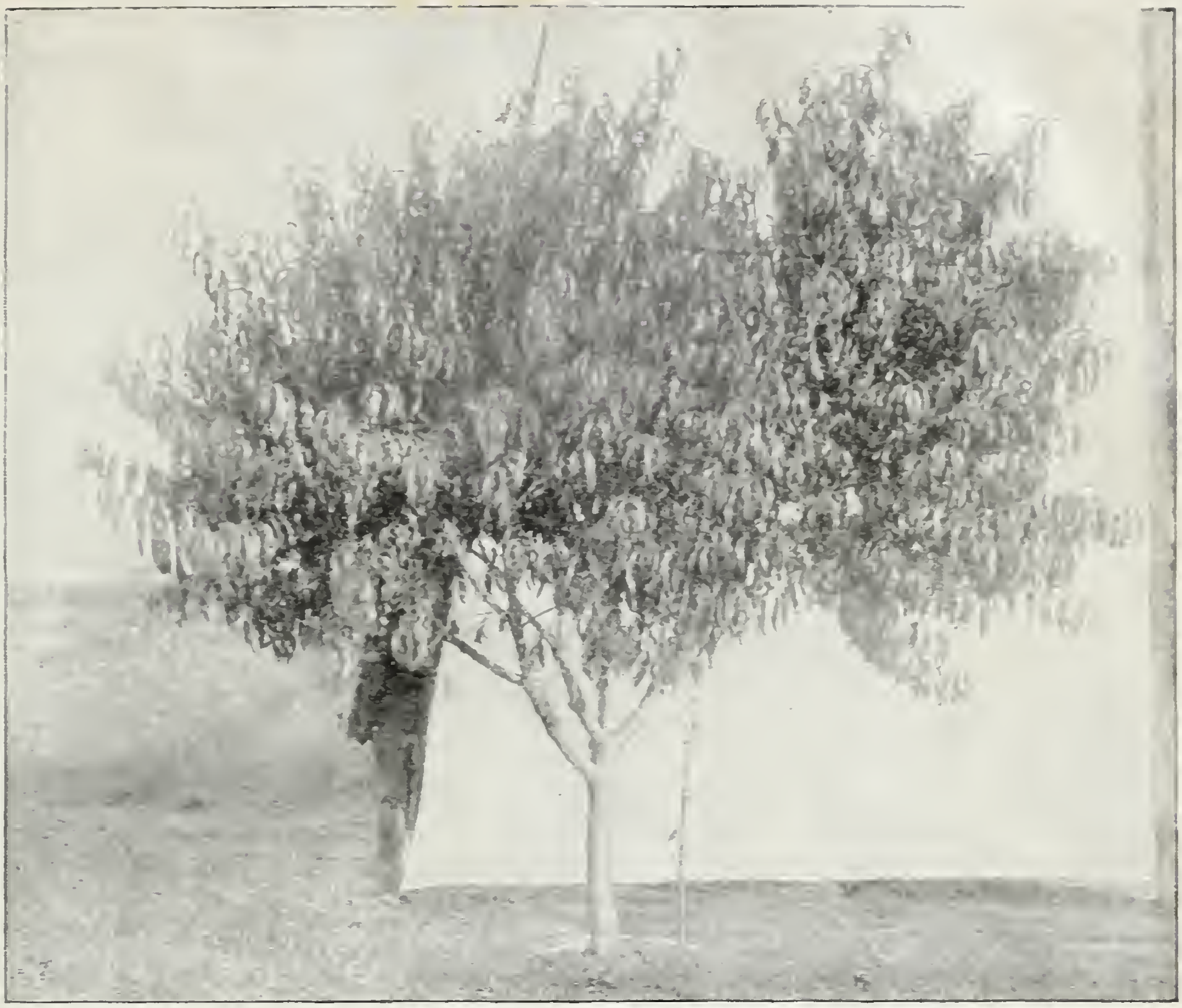
(Strictly comparable with Plate XIV.)



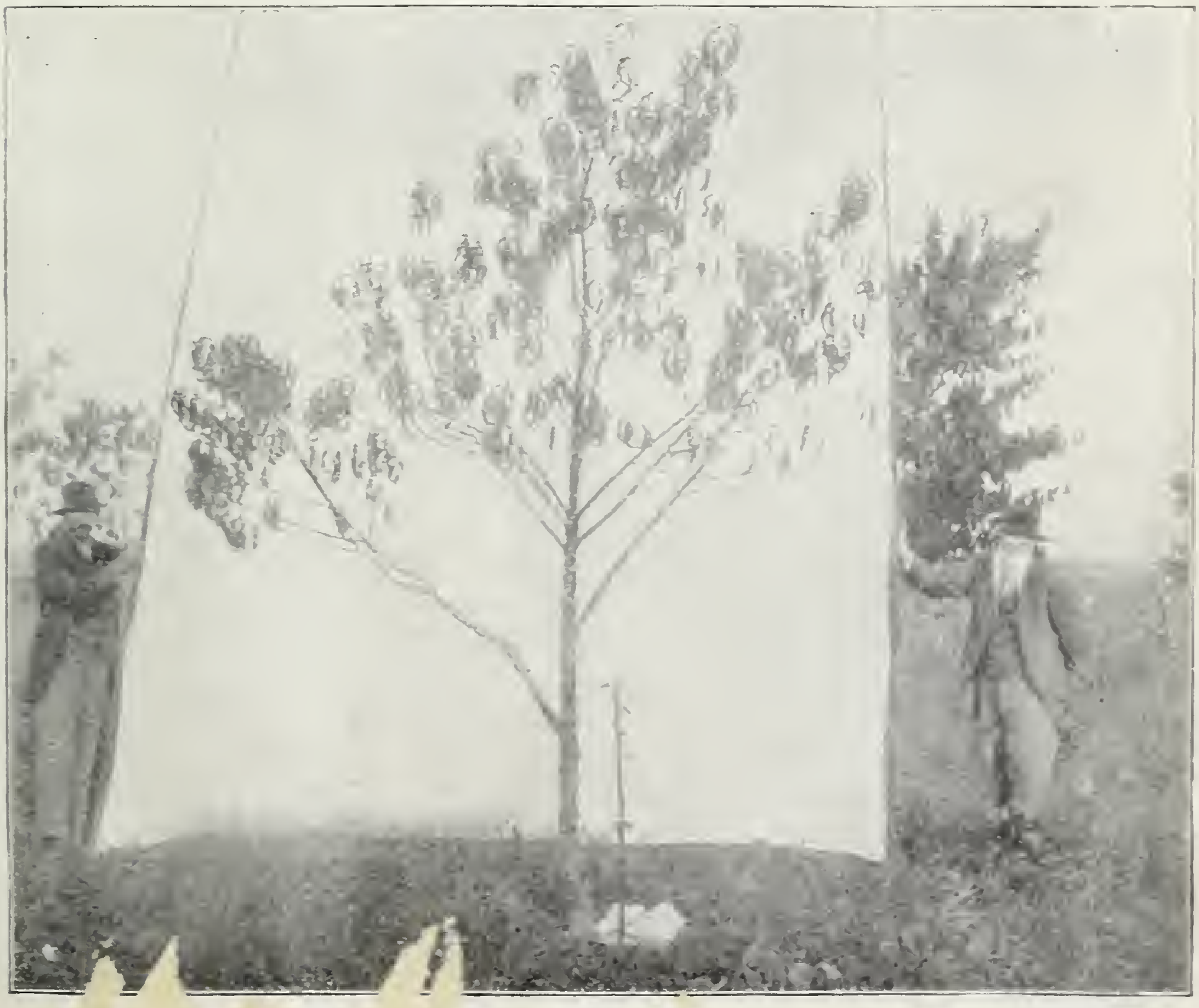
SERIES IX.—A VIEW IN THE MIDDLE OF THE ORCHARD SHOWING SIZE OF THE TREES AND AMOUNT OF FOLIAGE. OCTOBER 14, 1891.



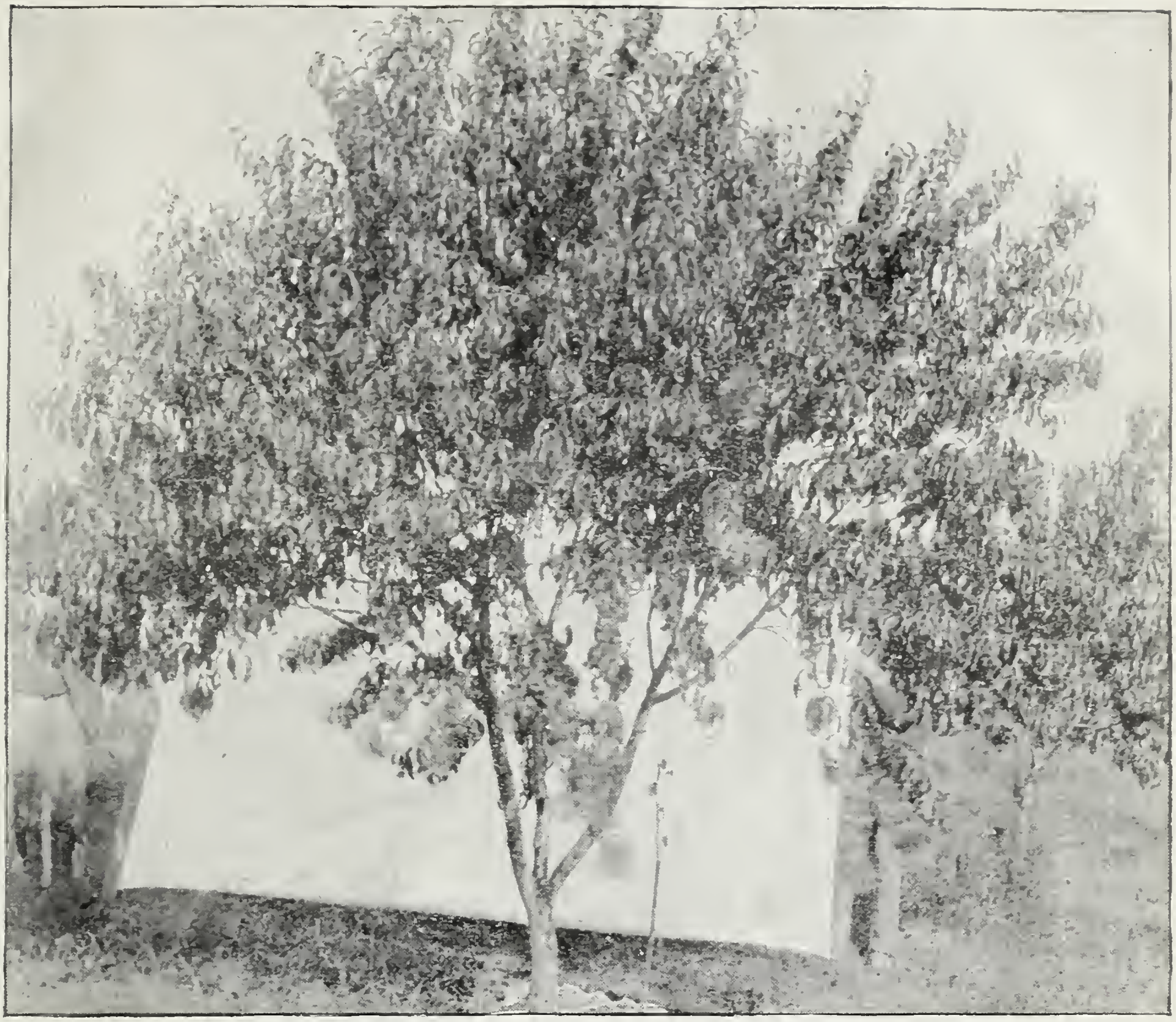
SERIES X.—EFFECT OF TOBACCO DUST ON DWARFED TREES NOT AFFECTED BY YELLOWS.
EXPERIMENT XC. OCTOBER 14, 1891.



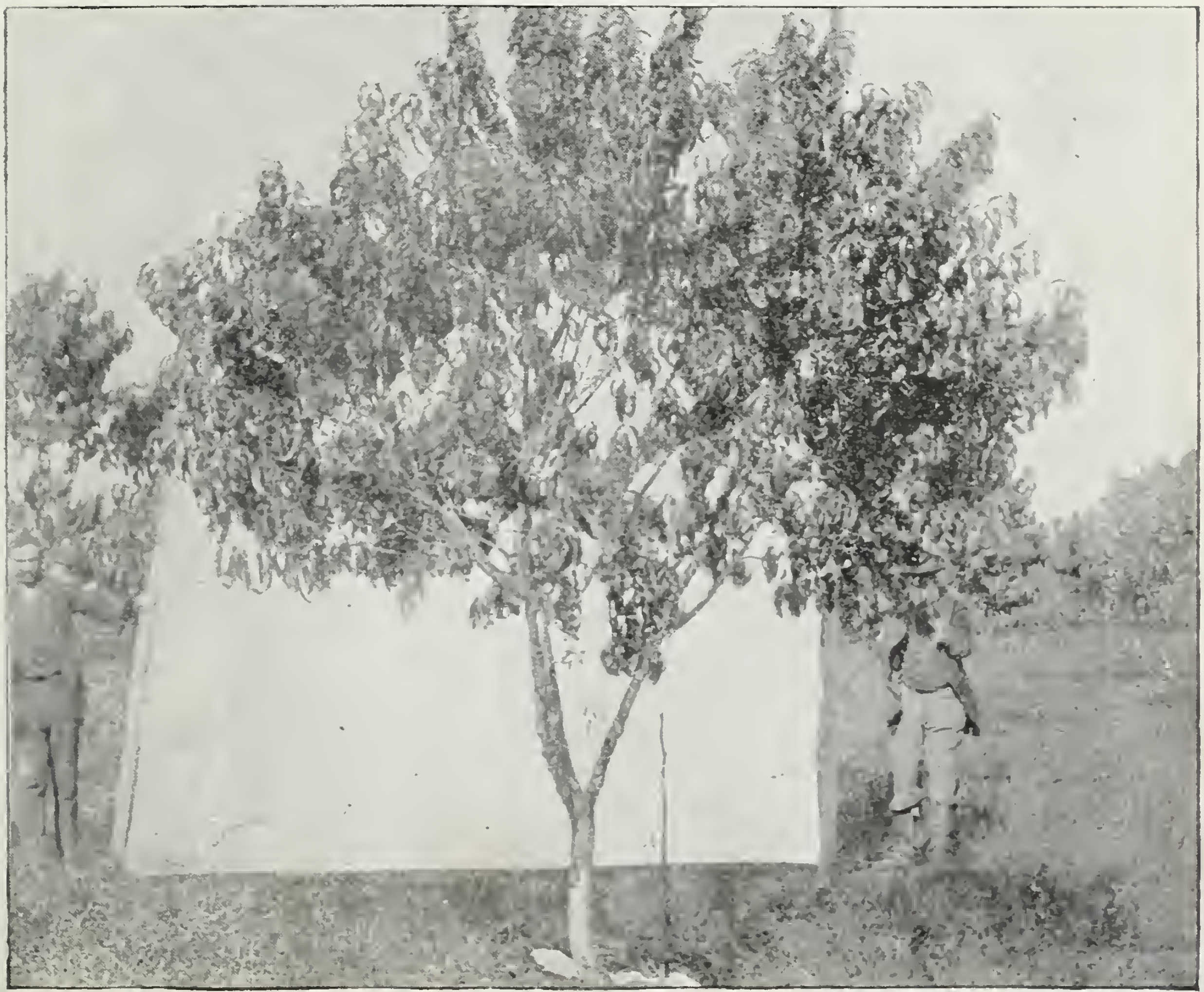
Series XII.—Fig. 1. Dissolved Boneblack and Muriate of Potash. Plat C.
Healthy Tree. October 4, 1890.



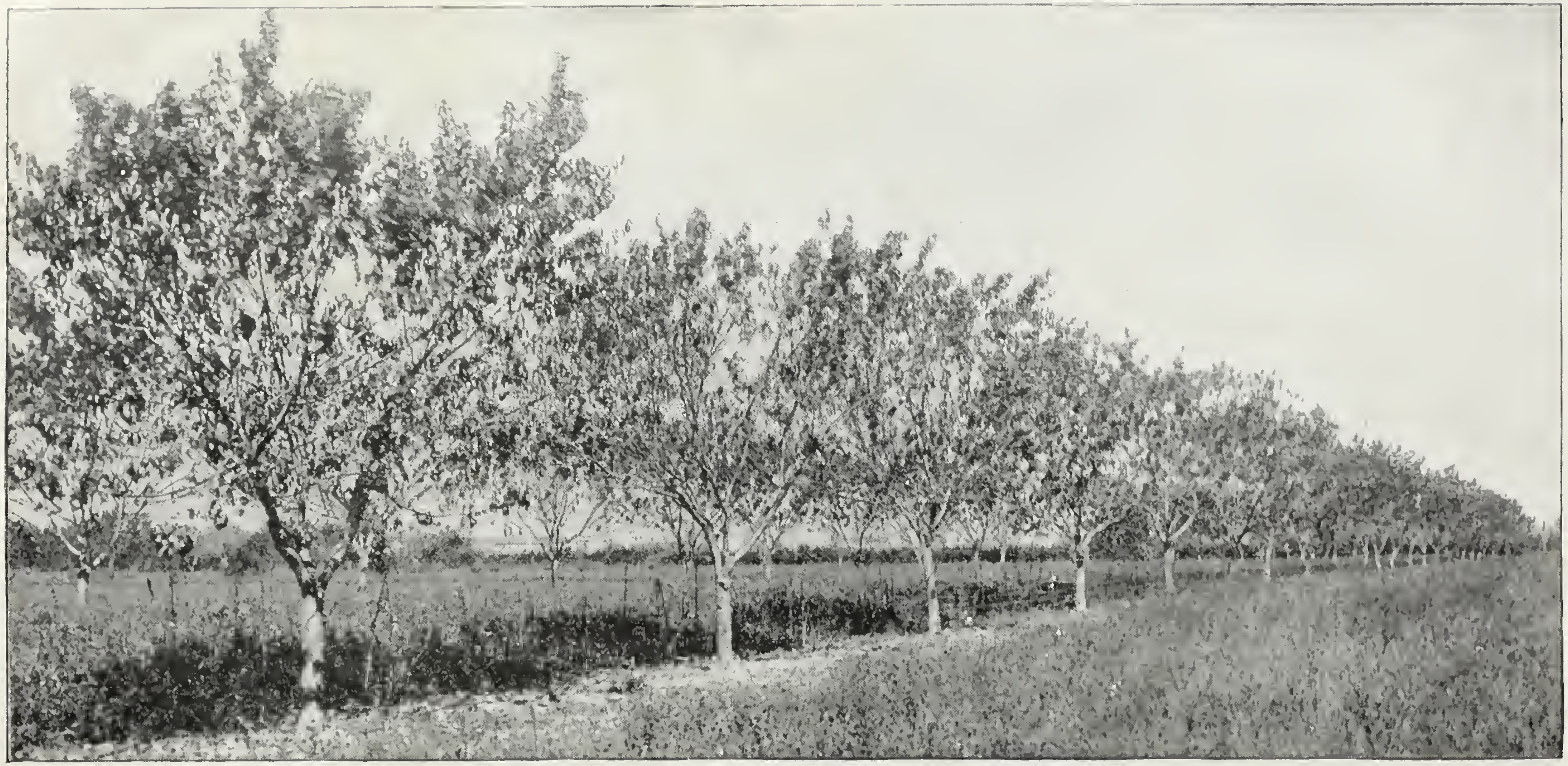
Se[illegible]—F[illegible] 2. Diss[illegible] Boneblack and Muriate of Potash. Case of 1889.
P[illegible] C. Fo[illegible] by Two Treatments. October 4, 890.



SERIES XII.—FIG. 1. DISSOLVED BONEBLACK AND NITRATE OF POTASH. PLAT CII.
HEALTHY TREE. OCTOBER 4, 1890.



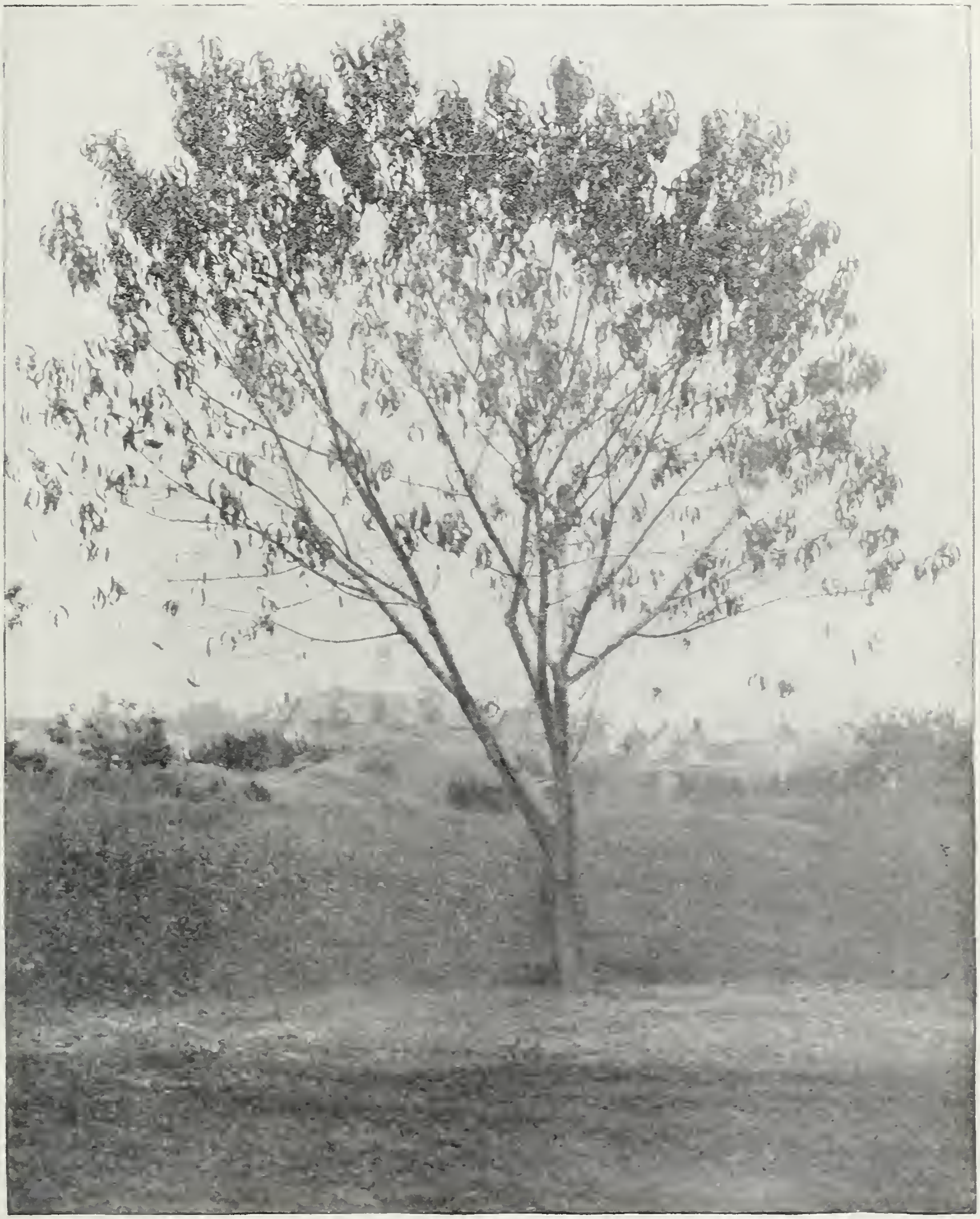
SERIES XII.—FIG. 2. DISSOLVED BONEBLACK AND NITRATE OF POTASH. PLAT CIII.
CASE OF 1890, AFTER TWO TREATMENTS. OCTOBER 4, 1890.



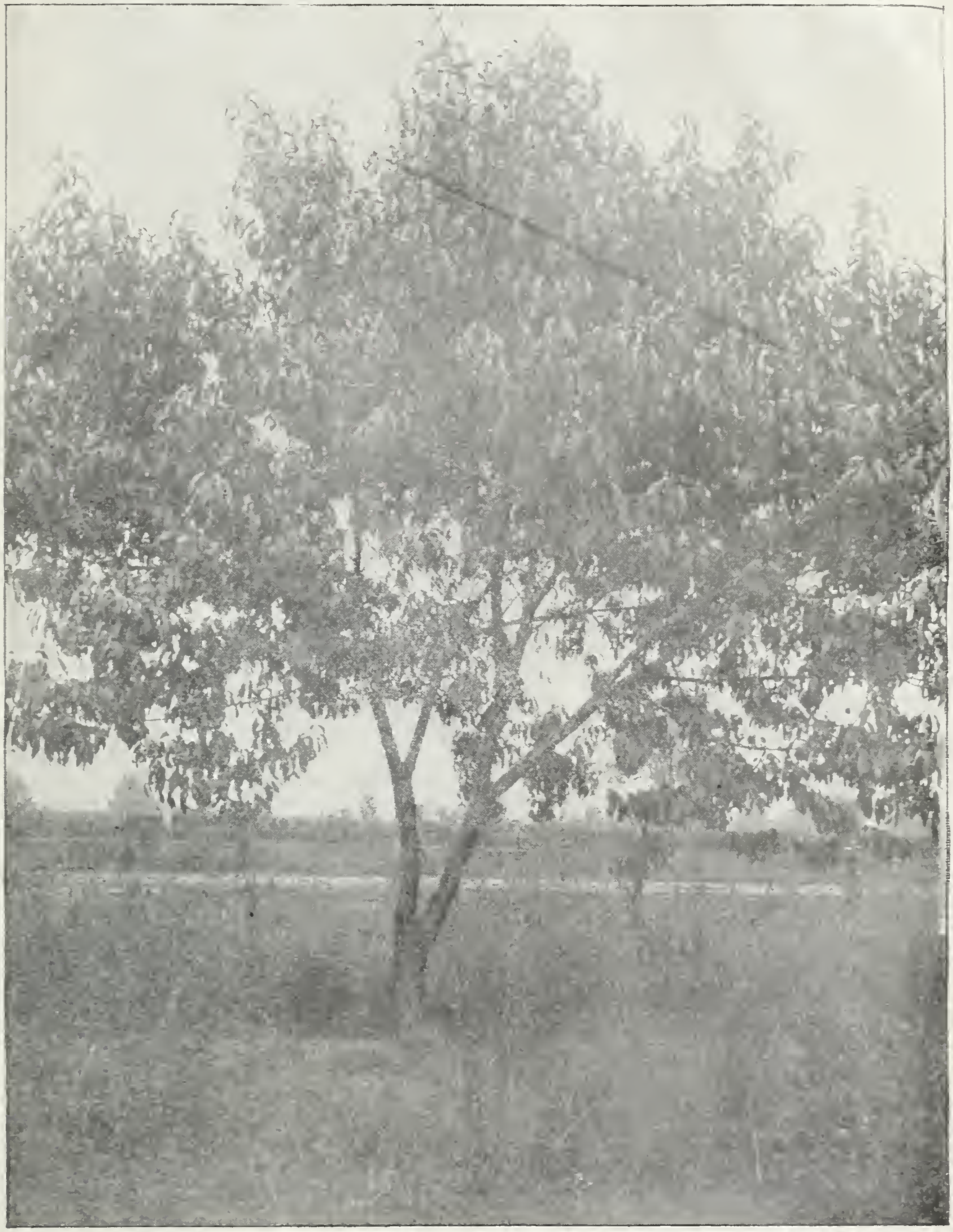
SERIES XIV.—UNTREATED ROW—I. E., SIXTY-FIRST CONTROL.

(Photographed Sept. 30, 1890.)

AF



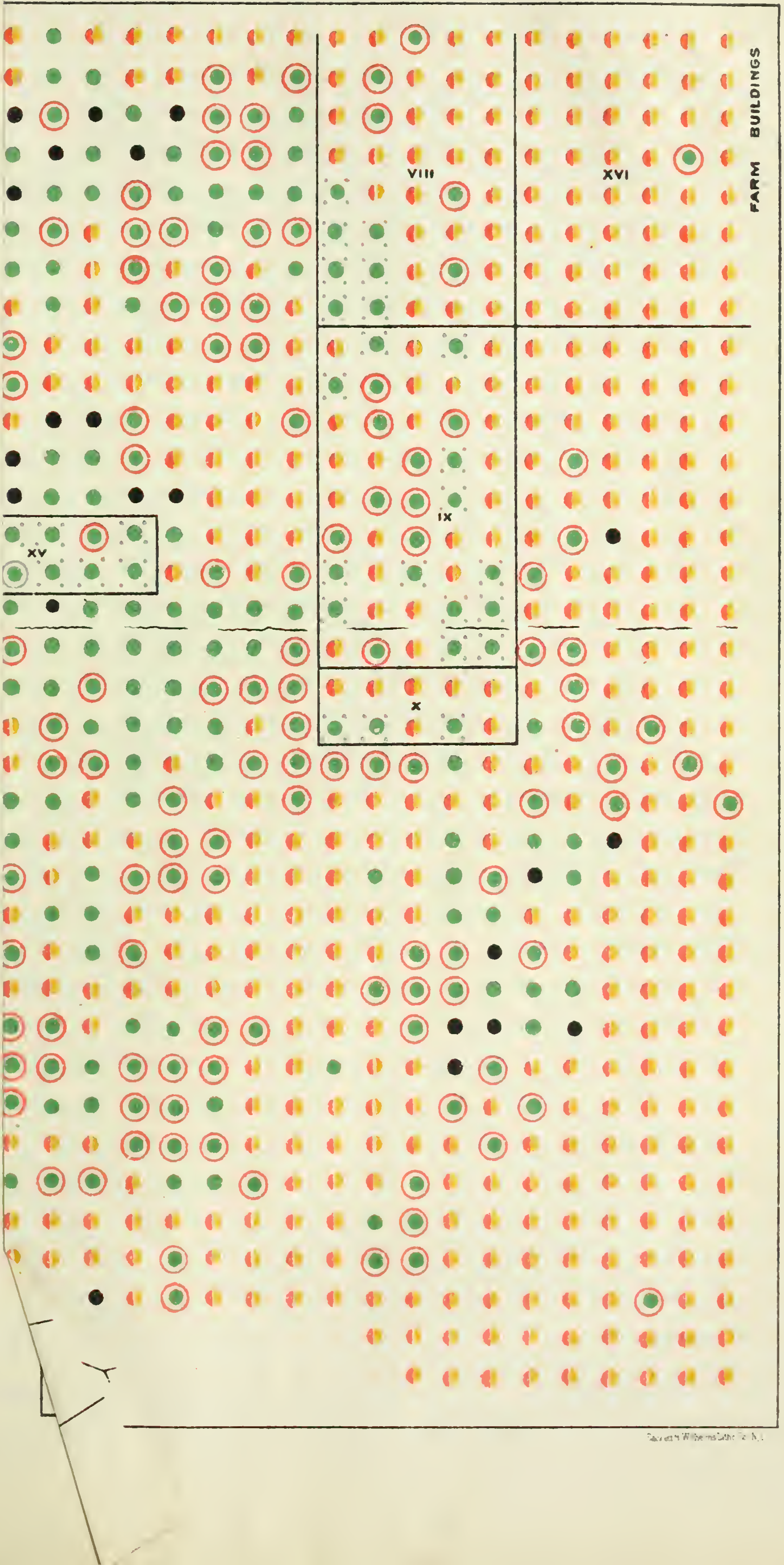
SERIES XIV.—DISSOLVED BONE ASH AND MURIATE OF POTASH, I. E., AN INCOMPLETE FERTILIZER. PLAT CVI. SEPTEMBER 30, 1890.



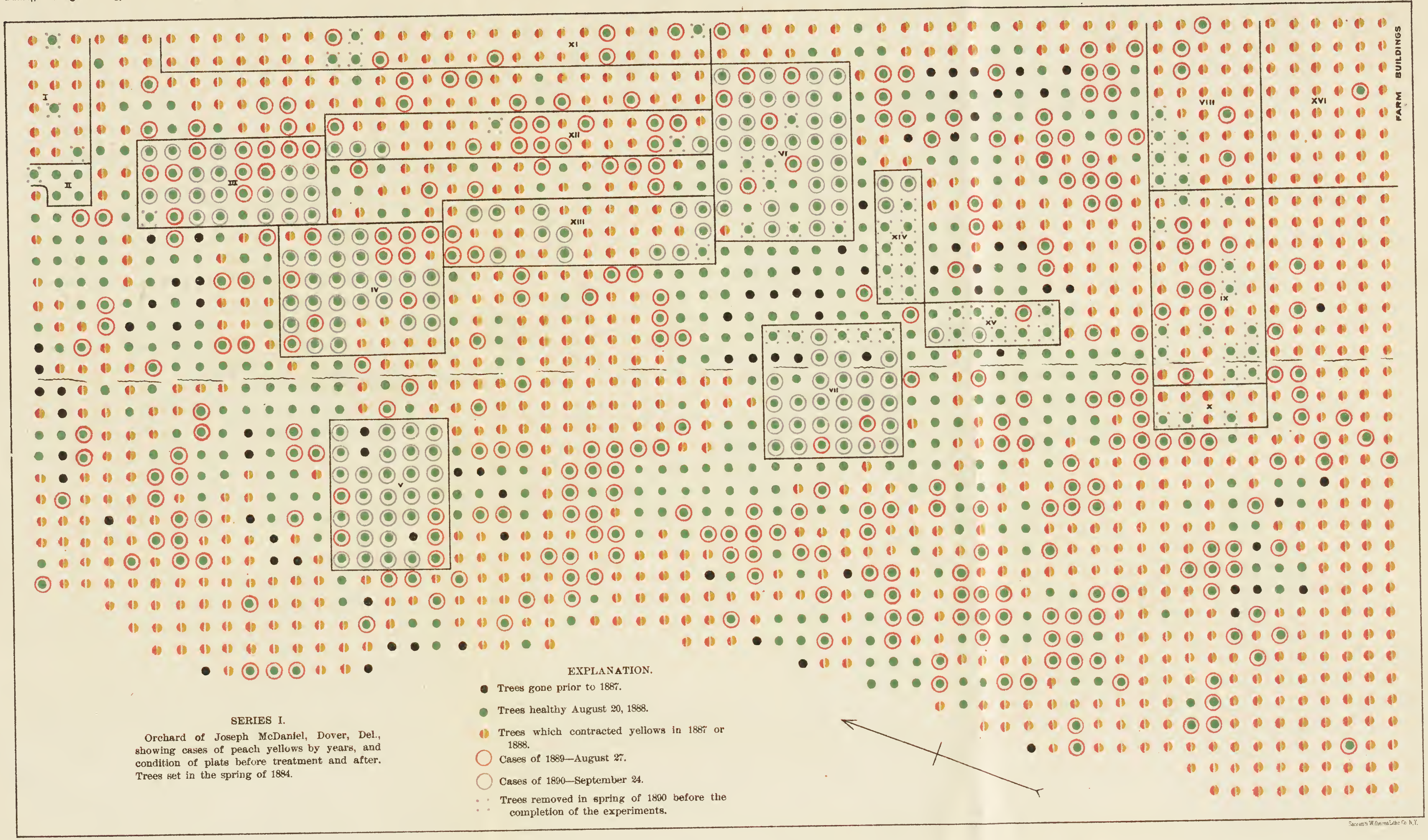
SERIES XIV.—DISSOLVED BONE ASH AND NITRATE OF POTASH. I. E., A "COMPLETE" FERTILIZER. PLAT CVII. SEPTEMBER 30, 1890.

(Strictly comparable with Plate XXI.)

PLATE XXIII.



Sackett & Wilhelms Litho. Co. N.Y.



SERIES I.

Orchard of Joseph McDaniel, Dover, Del., showing cases of peach yellows by years, and condition of plats before treatment and after. Trees set in the spring of 1884.

EXPLANATION.

● Trees gone prior to 1887.

● Trees healthy August 20, 1888.

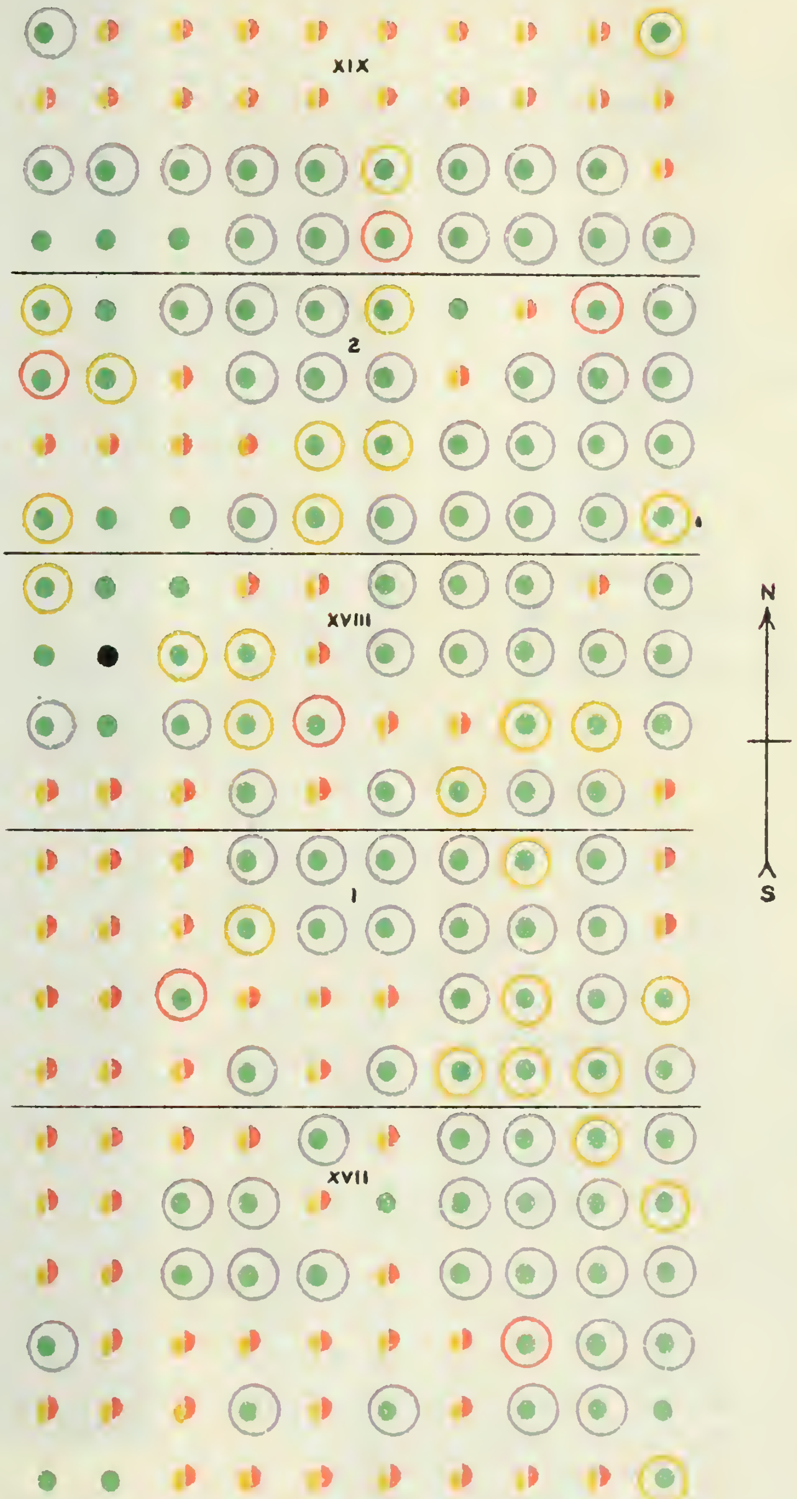
◐ Trees which contracted yellows in 1887 or 1888.

○ Cases of 1889—August 27.

○ Cases of 1890—September 24.

∴ Trees removed in spring of 1890 before the completion of the experiments.

Sackett & Wilhelms Litho Co. N.Y.



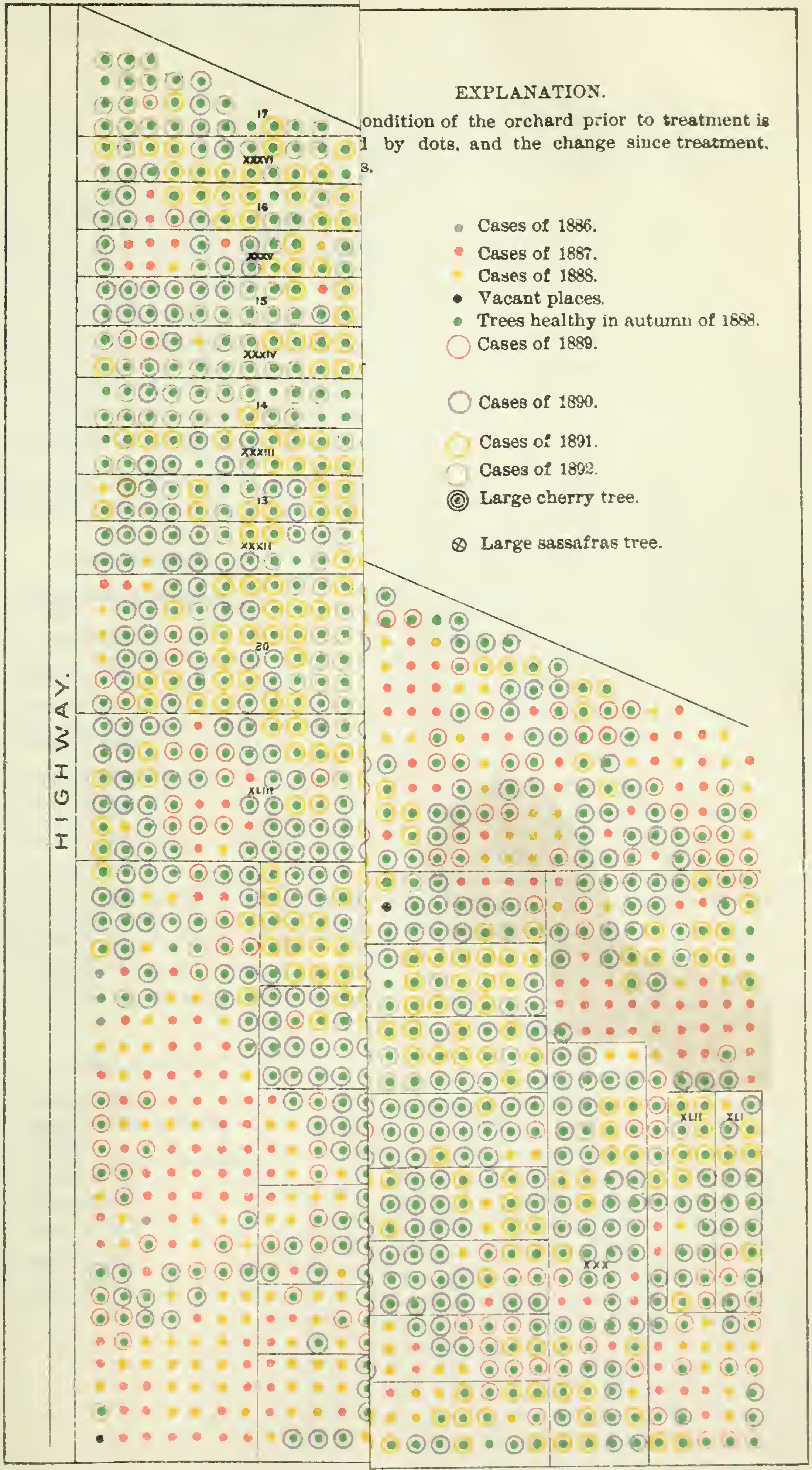
EXPLANATION.

● Trees healthy in spring of 1889.
● Tree gone in spring of 1889.
◐ Cases of 1887 or 1888.
○ Cases of 1889.
○ Cases of 1890.
○ Cases of 1891.

SERIES II.

Orchard of M. Hays, Dover, Delaware. Showing cases of peach yellows by years, and results of experiments with fertilizers. Trees set in the spring of 1884.

Sackett & Wilhelms Lith. Co. N.Y.

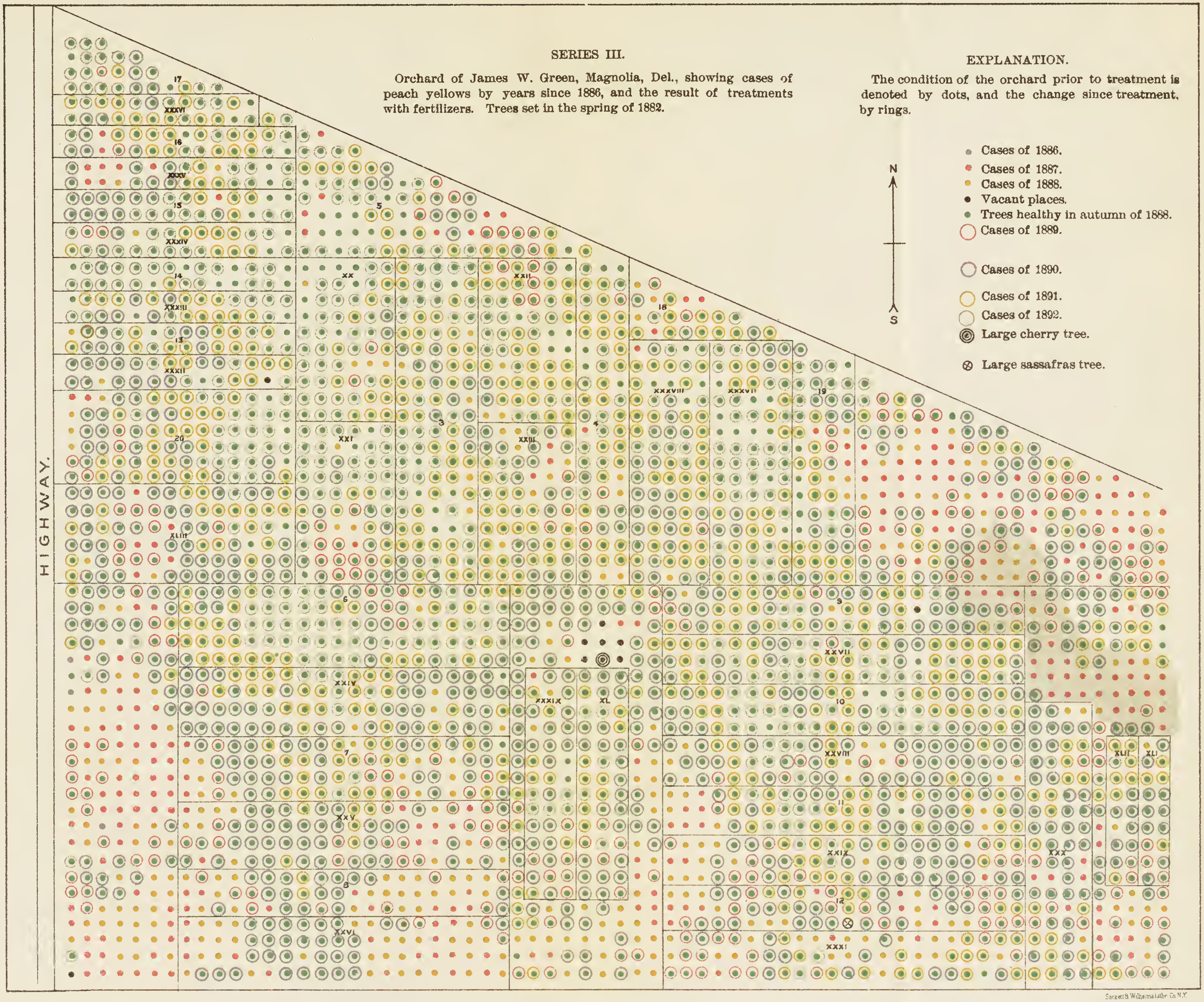


EXPLANATION.

ondition of the orchard prior to treatment is
l by dots, and the change since treatment.
s.

- ● Cases of 1886.
- ● Cases of 1887.
- ● Cases of 1888.
- ● Vacant places.
- ● Trees healthy in autumn of 1888.
- ○ Cases of 1889.
- ○ Cases of 1890.
- ○ Cases of 1891.
- ○ Cases of 1892.
- ◎ Large cherry tree.
- ⊗ Large sassafras tree.

Sackett & Wilhelms Litho. Co. N.Y.



SERIES III.

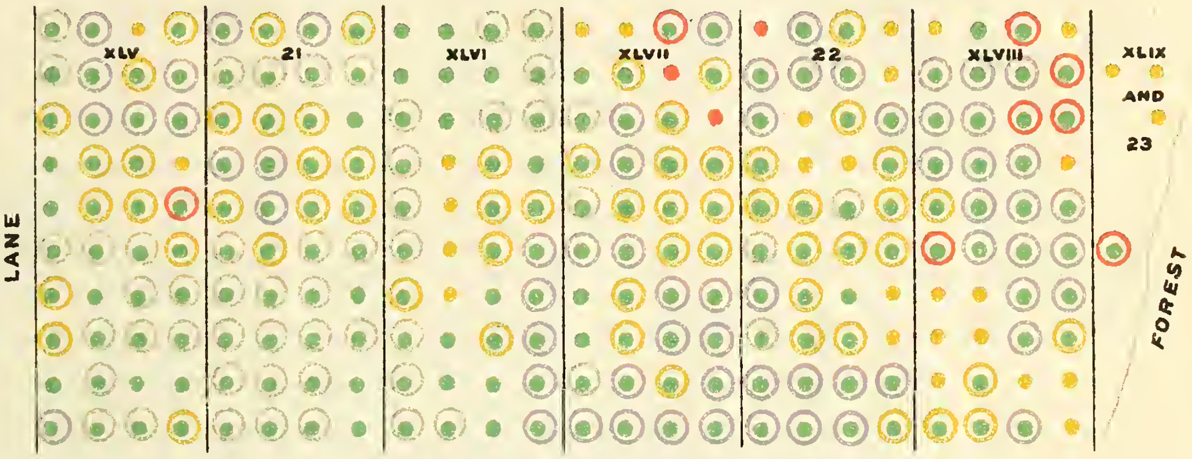
Orchard of James W. Green, Magnolia, Del., showing cases of peach yellows by years since 1886, and the result of treatments with fertilizers. Trees set in the spring of 1882.

EXPLANATION.

The condition of the orchard prior to treatment is denoted by dots, and the change since treatment, by rings.

- ● Cases of 1886.
- ● Cases of 1887.
- ● Cases of 1888.
- ● Vacant places.
- ● Trees healthy in autumn of 1888.
- ○ Cases of 1889.
- ○ Cases of 1890.
- ○ Cases of 1891.
- ○ Cases of 1892.
- ◎ Large cherry tree.
- ⊗ Large sassafras tree.

Sackett & Wilhelms Litho. Co. N.Y.

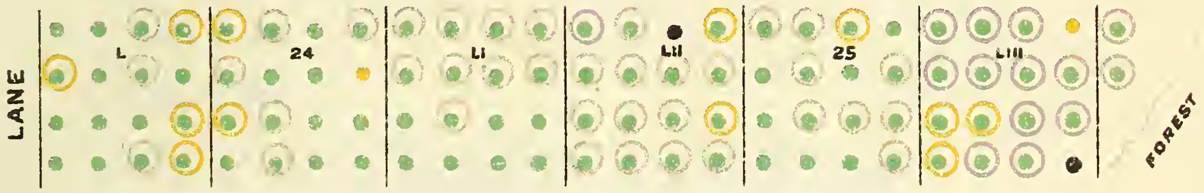


EXPLANATION.

- 🟢 Trees healthy in spring of 1889.
- 🔴 Cases of 1887.
- 🟡 Cases of 1888.
- ● Vacant places.
- ⭕ Cases of 1889.
- ○ Cases of 1890.
- ○ Cases of 1891.
- ◌ Cases of 1892.

SERIES IV.

Orchard of Dr. W. S. Maxwell, Still Pond, Maryland, showing cases of yellows by years, and the result of experiments with fertilizers. Trees set in the fall of 1884.



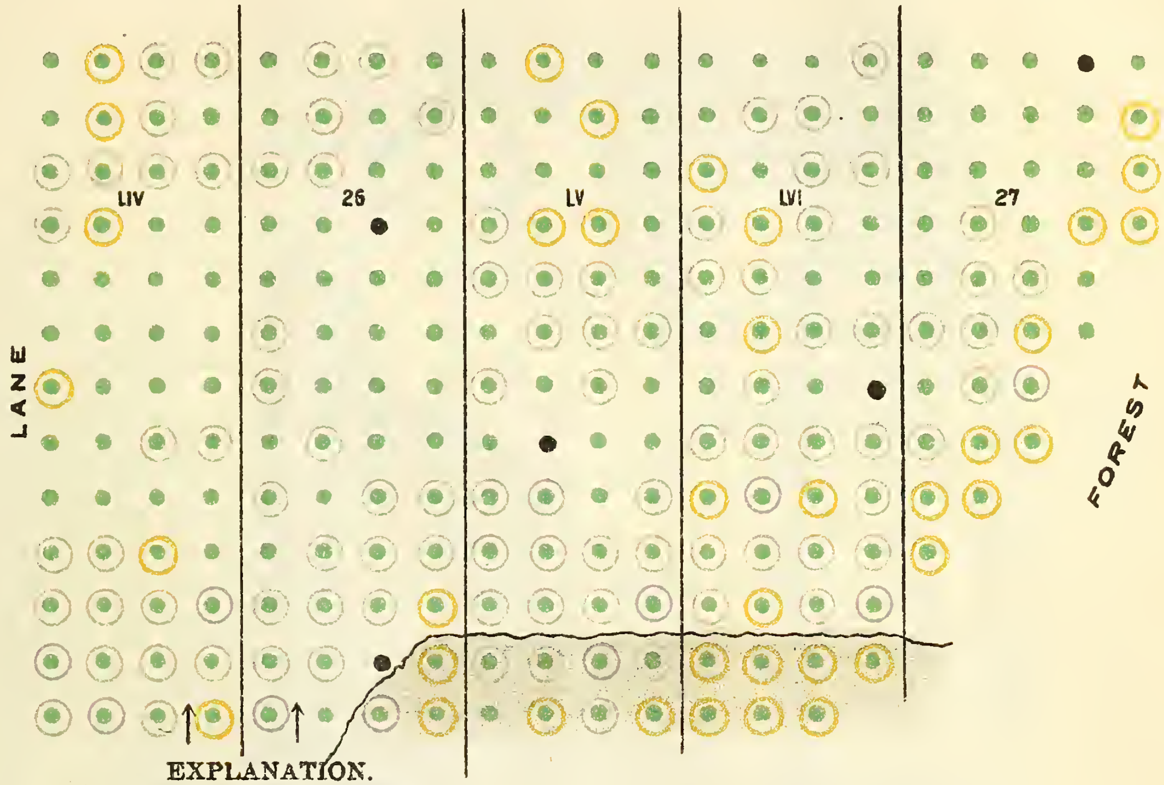
EXPLANATION.

- 🟡 Cases of 1888.
- 🟢 Trees healthy in spring of 1889.
- ● Vacant places — probably cases of 1887.
- ⭕ Cases of 1889.
- ○ Cases of 1890.
- ○ Cases of 1891.
- ◌ Cases of 1892.

SERIES V.

Orchard of Dr. W. S. Maxwell, Still Pond, Maryland, showing cases of peach yellows by years, and result of experiments with fertilizers. Trees set in the fall of 1885.

Sackett & Wilhelms Litho. Co. N.Y.

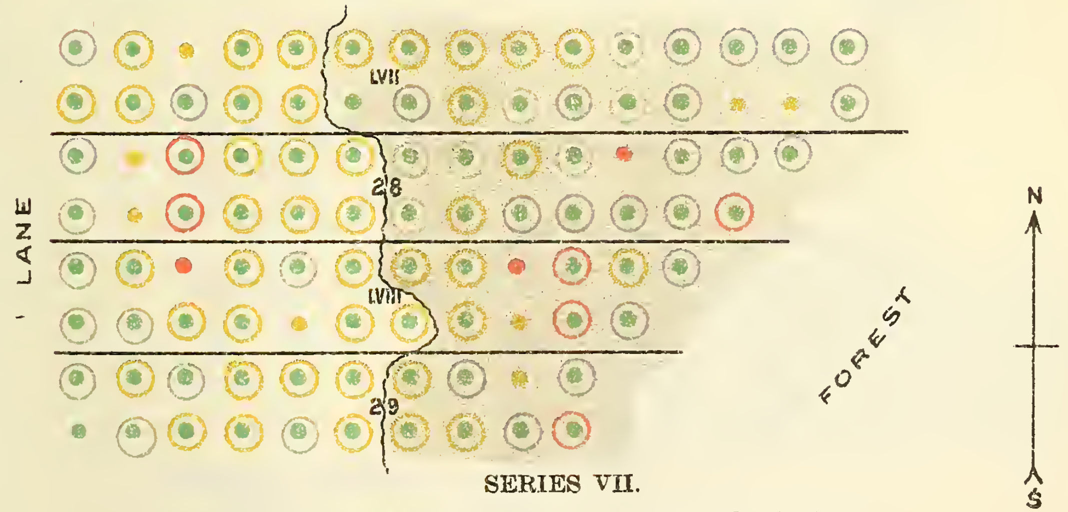


EXPLANATION.

- ● Trees healthy in spring of 1889.
- ○ Cases of 1890.
- ○ Cases of 1891.
- ● Trees gone, but not on account of yellows.
- ○ Cases of 1892.
- ● Cases of 1887.
- ● Cases of 1888.
- ○ Cases of 1889.

SERIES VI.

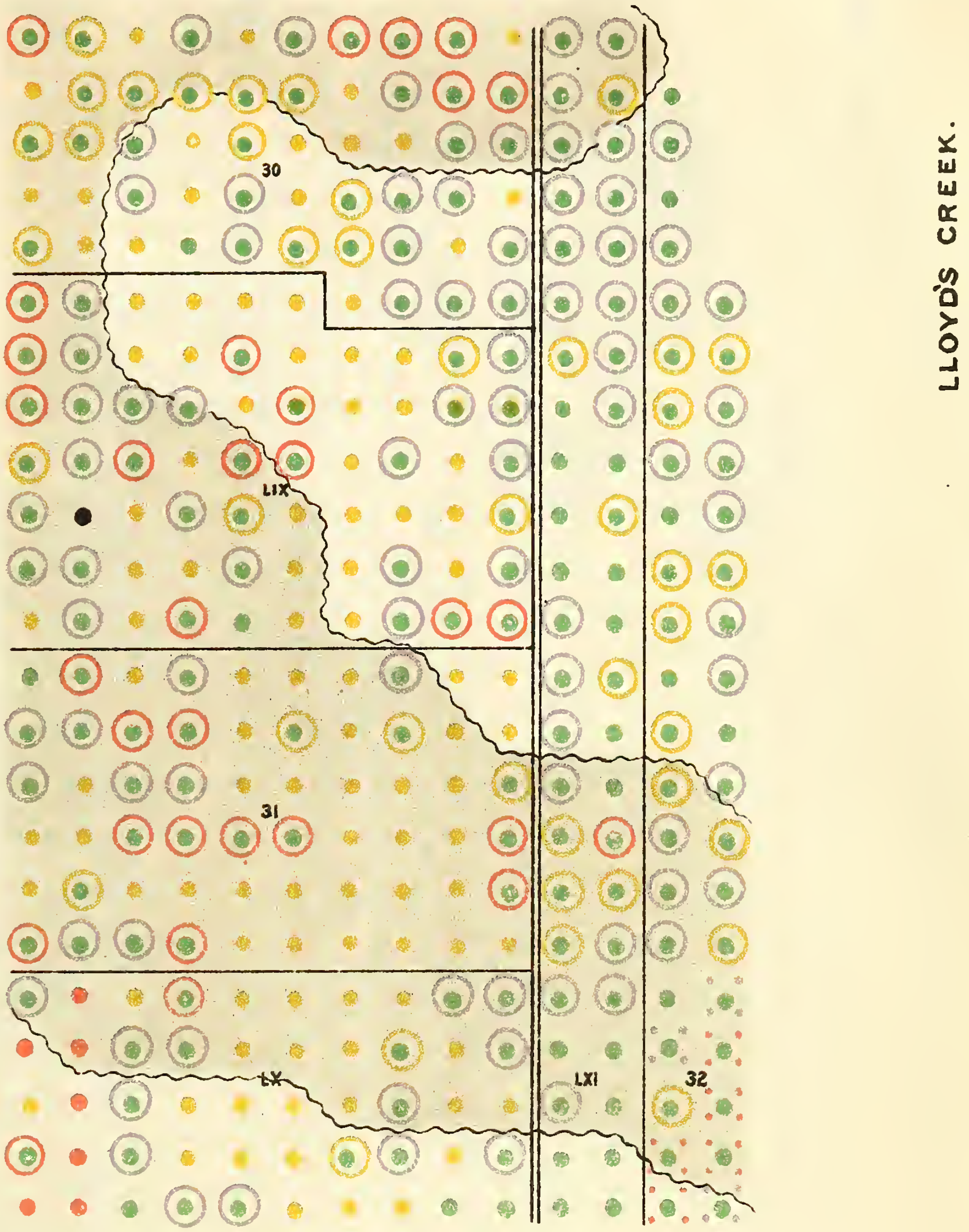
Orchard of Dr. W. S. Maxwell, Still Pond, Md., showing cases of peach yellows by years, and the result of experiments with fertilizers. Trees set in the fall of 1886.



SERIES VII.

Orchard of Dr. W. S. Maxwell, Still Pond, Md., showing cases of peach yellows by years, and the result of experiments with fertilizers. Trees set in the fall of 1885.

Sackett & Wilhelms Litho Co N.Y.



EXPLANATION.

● Cases of 1887.
● Cases of 1888.
● Trees healthy in spring of 1889.
○ Cases of 1889.
○ Cases of 1890.
○ Cases of 1891.
∴ Killed by root aphides in 1889.
∴ Killed by root aphides in 1890.
∴ Killed by root aphides in 1891.

SERIES VIII.

Orchard of Dr. W. S. Maxwell, Still Pond, Md., showing cases of peach yellows by years, and result of experiments with fertilizers. The trees on the east side are one year younger than the rest of the orchard. Oldest trees set in November, 1885.

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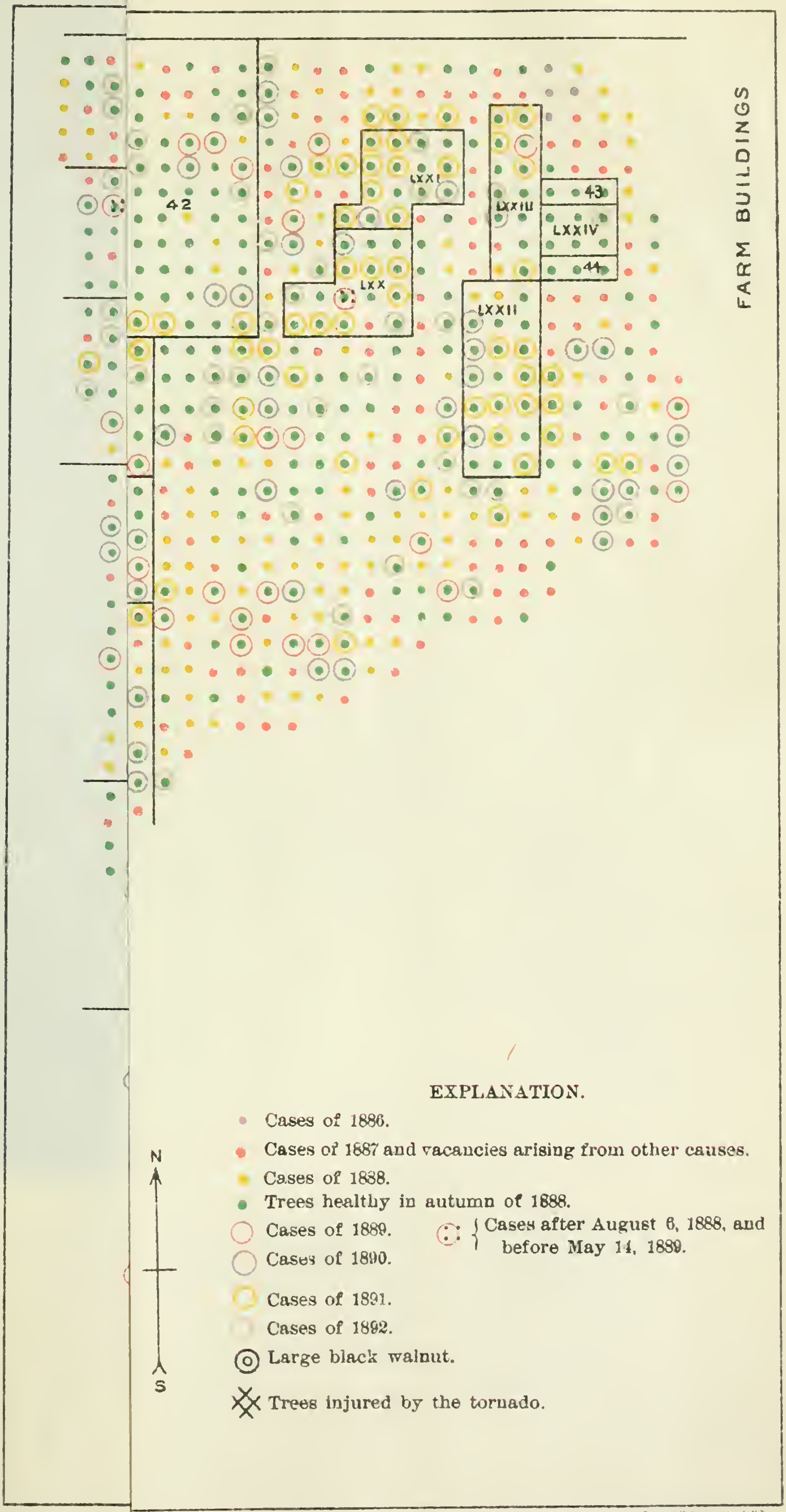
PLATE XXIX.



EXPLANATION.

- ● Cases of 1886.
- ● Cases of 1887 and vacancies arising from other causes.
- ● Cases of 1888.
- ● Trees healthy in autumn of 1888.
- ○ Cases of 1889.
- ○ Cases of 1890.
- ○ Cases of 1891.
- ○ Cases of 1892.
- ◎ Large black walnut.
- ⁙ Cases after August 6, 1888, and before May 14, 1889.
- ✕ Trees injured by the tornado.

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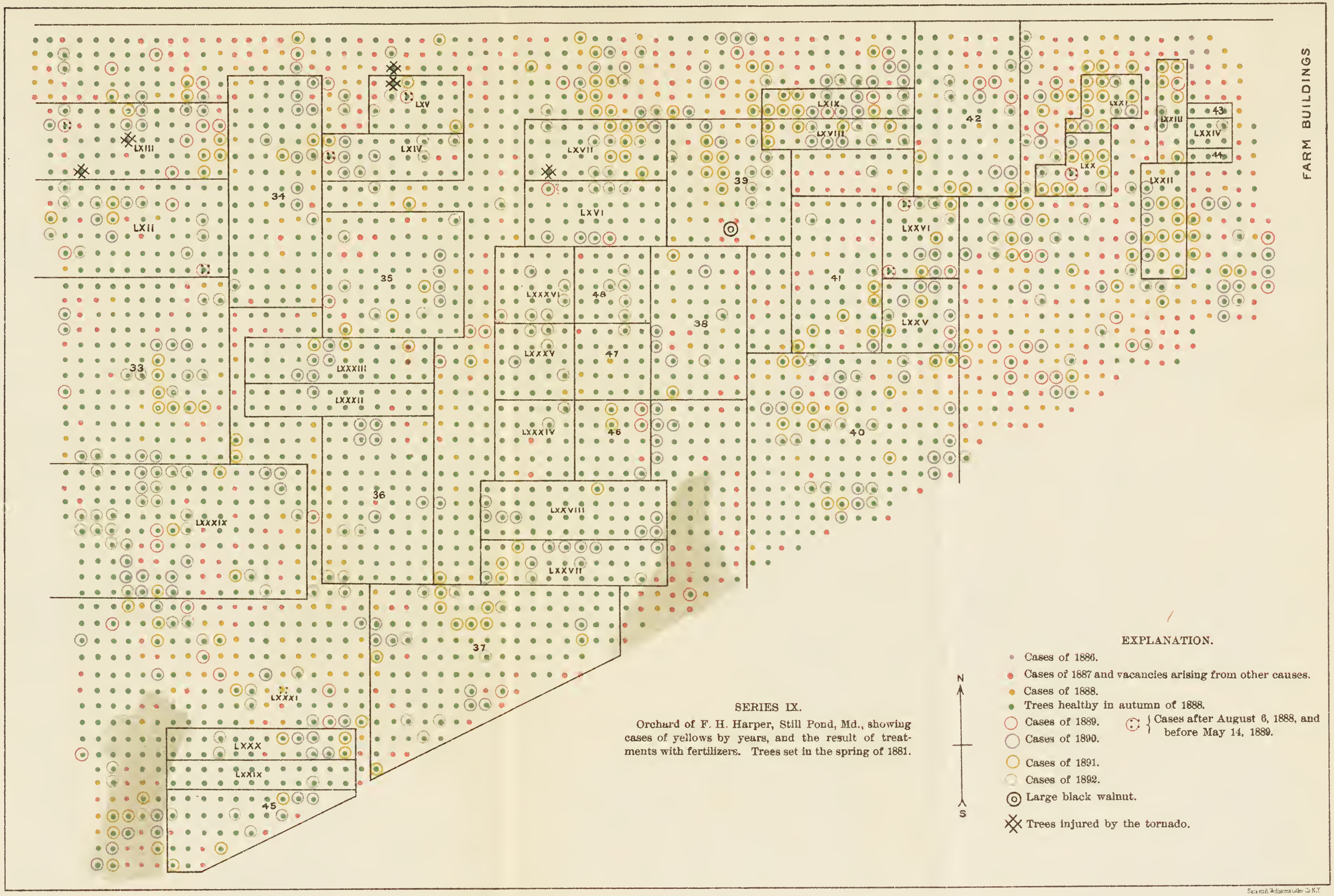
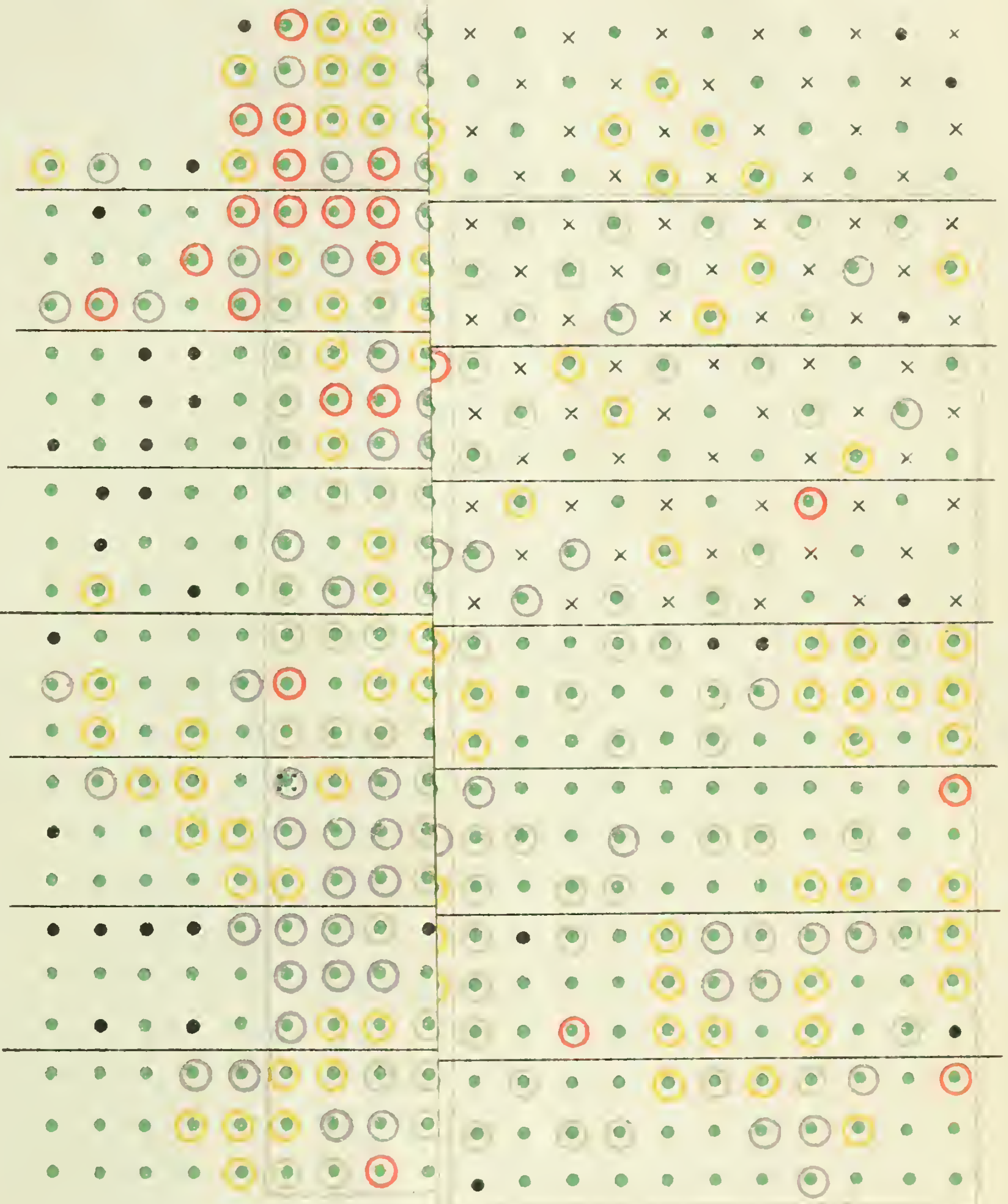


SERIES IX.

Orchard of F. H. Harper, Still Pond, Md., showing cases of yellows by years, and the result of treatments with fertilizers. Trees set in the spring of 1881.

Sackett & Wilhelms Litho Co N.Y.

PLATE XXXI.



EXPLANA

- ● Trees healthy in sp
- ● Vacant places.
- ○ Cases of 1889.
- ○ Cases of 1890.
- ○ Cases of 1891.
- × Young apple trees.
- ∷ Experiment CIV.
- ○ Cases of 1892.

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ents with

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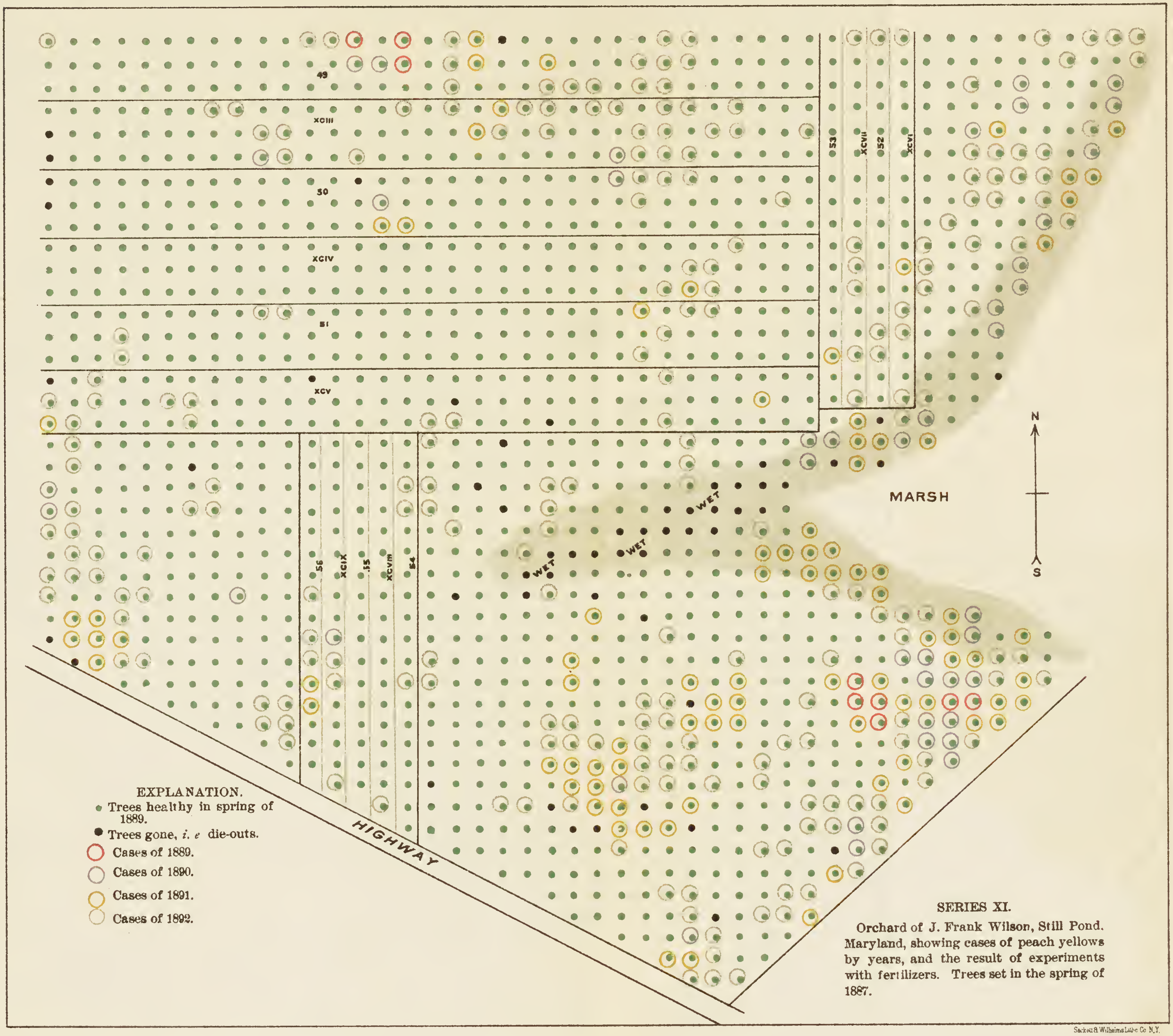

EXPLANATION.

● Trees healthy in spring of 1889.

● Trees gone, *i. e* die-outs.

○ Cases of 1889.

○ Cases of 1890.

○ Cases of 1891.

○ Cases of 1892.

SERIES XI.

Orchard of J. Frank Wilson, Still Pond, Maryland, showing cases of peach yellows by years, and the result of experiments with fertilizers. Trees set in the spring of 1887.

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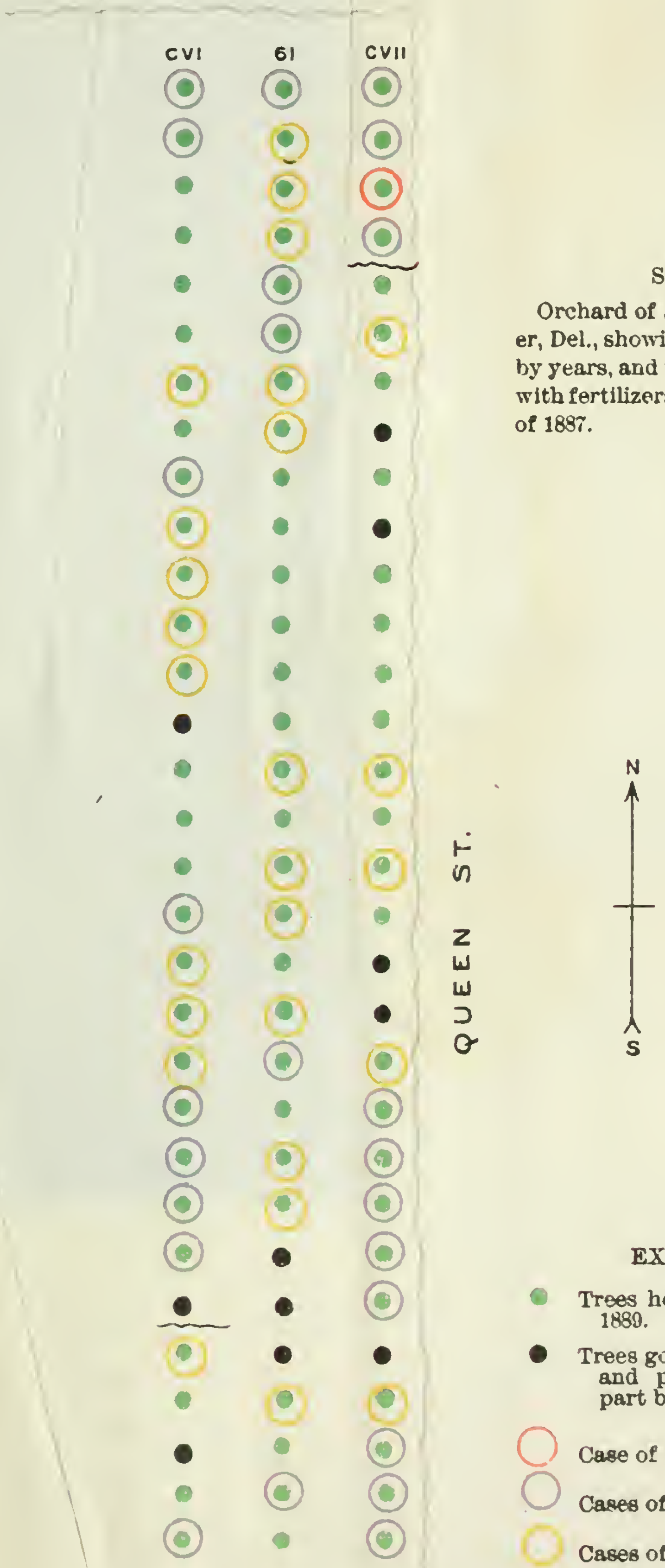
PLATE XXXII.



SERIES XIV.

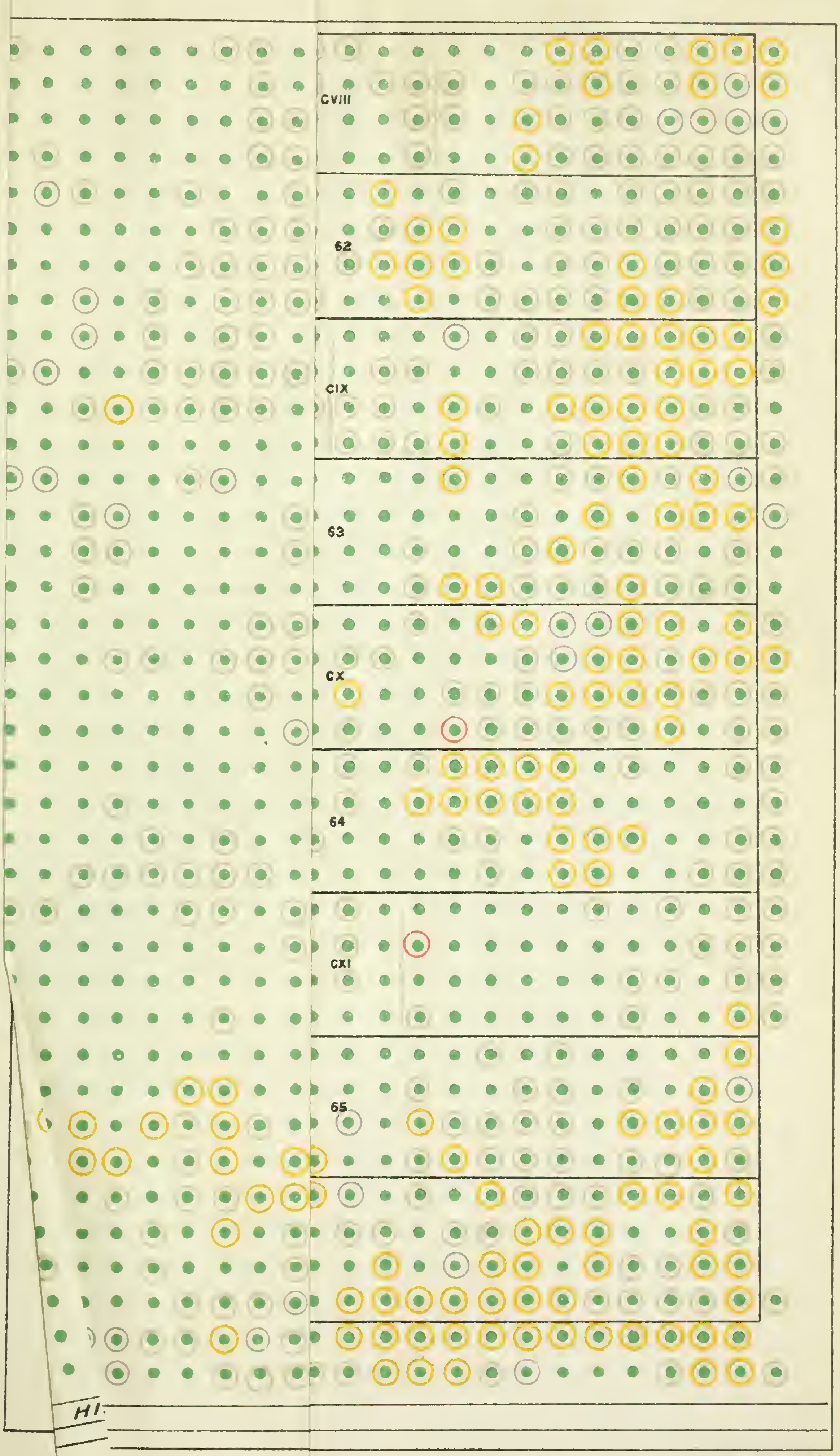
Orchard of James Alex. Fulton, Dover, Del., showing cases of peach yellows by years, and the result of experiments with fertilizers. Trees set in the spring of 1887.

EXPLANATION.

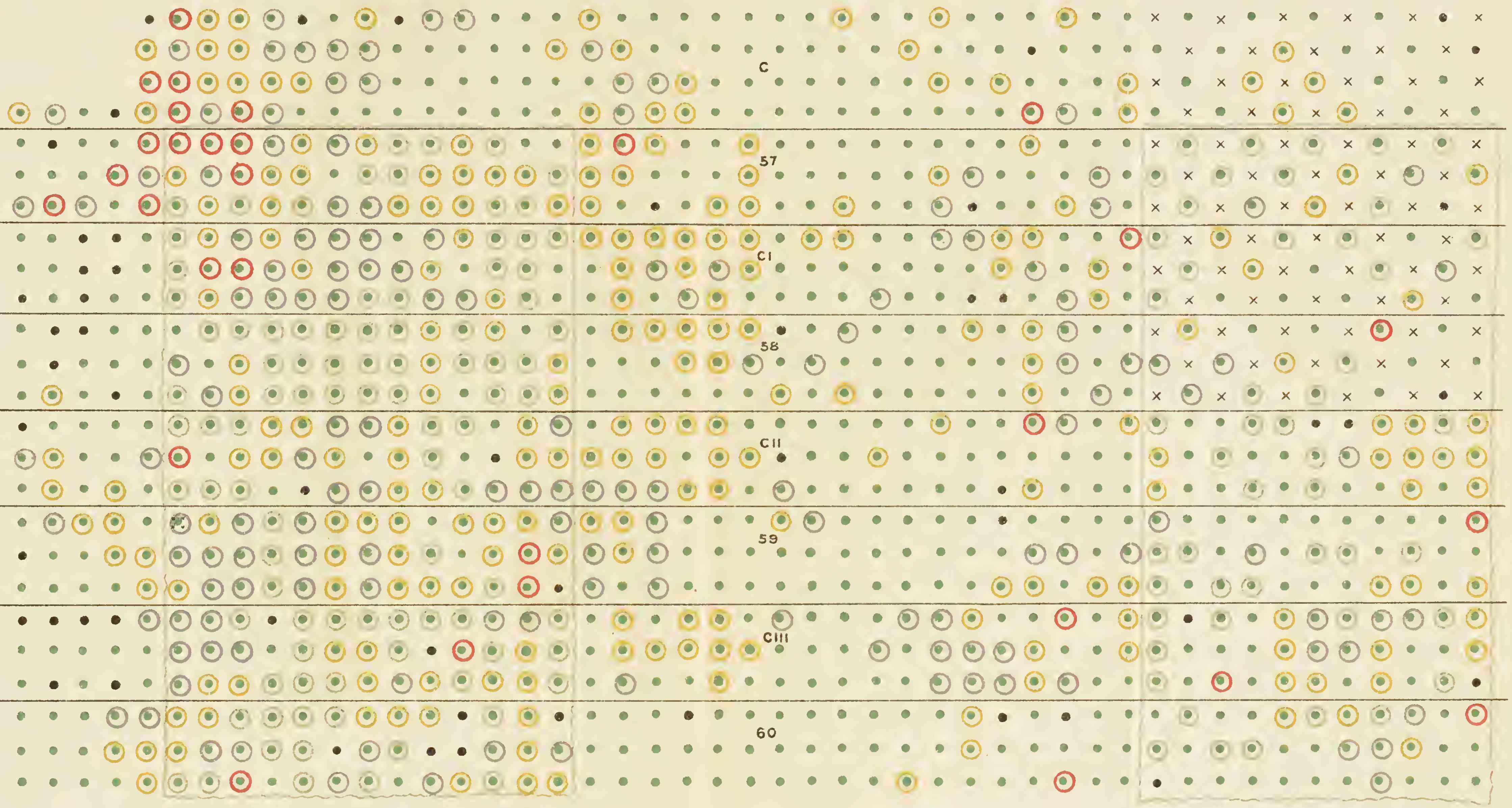
- 🟢 Trees healthy in spring of 1889.
- ● Trees gone in spring of 1889 and places occupied in part by cherry trees.
- ○ Case of 1889.
- ○ Cases of 1890.
- ○ Cases of 1891.

Sackett & Wilhelms Litho. Co. N.Y.

PLATE XXXIII.



Sarony & Wilhelms Lith. Co. N.Y.



EXPLANATION.

● Trees healthy in spring of 1889.

● Vacant places.

○ Cases of 1889.

○ Cases of 1890.

○ Cases of 1891.

× Young apple trees.

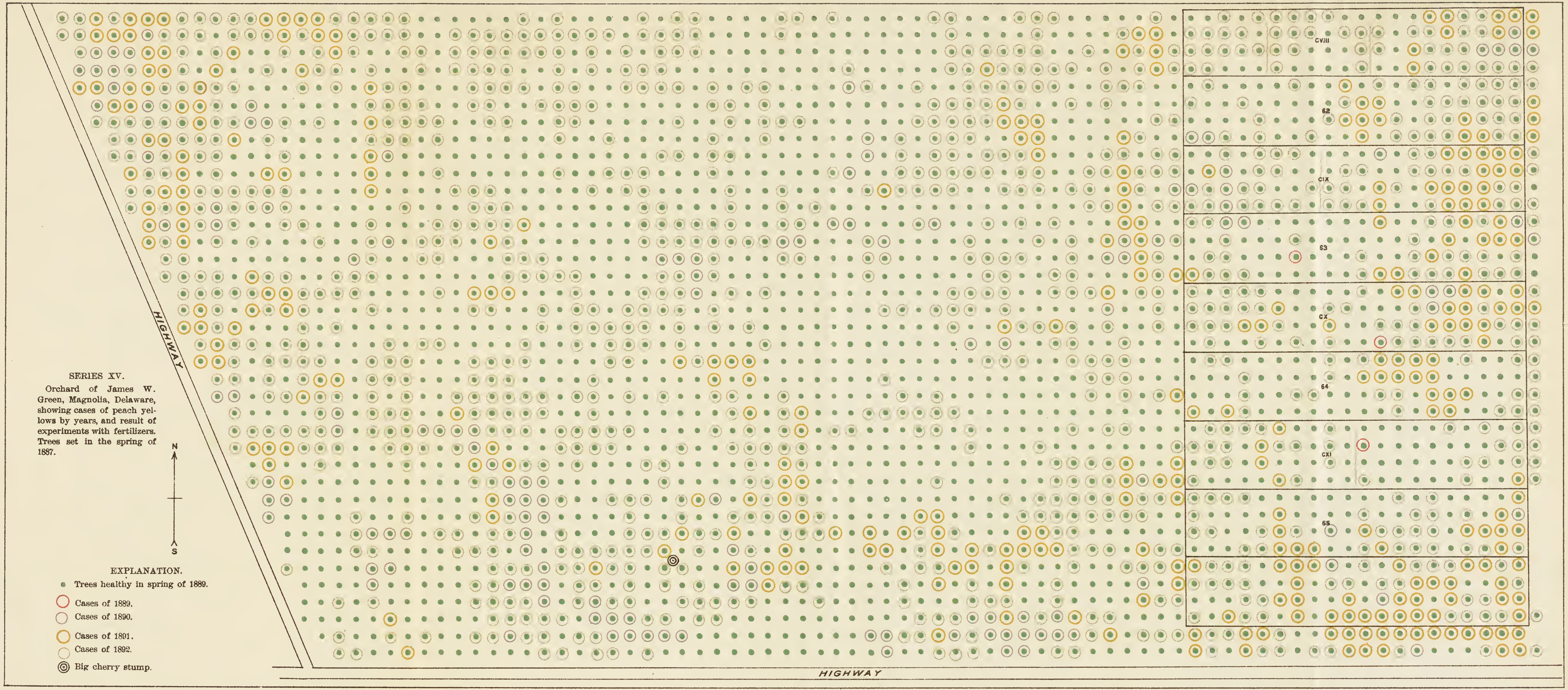
⁚ Experiment CIV.

○ Cases of 1892.

SERIES XII.

Orchard of W. O. Shallcross, Locust Grove, Md., showing cases of peach yellows by years, and the result of experiments with fertilizers. Trees set in the spring of 1887.

Sackett & Wilhelms Litho Co N.Y.



SERIES XV.

Orchard of James W. Green, Magnolia, Delaware, showing cases of peach yellows by years, and result of experiments with fertilizers. Trees set in the spring of 1887.

EXPLANATION.

● Trees healthy in spring of 1889.
○ Cases of 1889.
○ Cases of 1890.
○ Cases of 1891.
○ Cases of 1892.
◎ Big cherry stump.

Sackett & Wilhelms Litho Co. N.Y.

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